

EXHIBIT A

**IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF TEXAS**

WAPP TECH LIMITED PARTNERSHIP
and WAPP TECH CORP.,

Plaintiffs,

v.

BANK OF AMERICA CORP.,

Defendants.

C.A. No. 4:18-cv-00519-ALM

JURY TRIAL DEMANDED

DISCLOSURE OF INITIAL INFRINGEMENT CONTENTIONS
PURSUANT TO P.R. 3-1 AND 3-2

Plaintiffs Wapp Tech Limited Partnership and Wapp Tech Corp. (“Plaintiffs” or “Wapp”) makes the following infringement disclosures to Defendant Bank of America Corp. (“Bank of America”) under the Patent Local Rules with respect to U.S. Patent No. 9,971,678, (“the ‘678 patent”), U.S. Patent No. 9,298,864 (“the ‘864 Patent”), and U.S. Patent No. 8,924,192 (“the ‘192 patent”). Wapp’s investigation is ongoing, discovery has only just commenced, and the Defendant has yet to produce any documents in this case. Accordingly, Wapp’s disclosures are based on publicly available and/or publicly discernable materials regarding the accused instrumentalities that describe or discuss aspects of the operation of the instrumentalities. Wapp reserves the right to supplement or alter its disclosures herein based on additional information obtained through further investigation, discovery, claim construction, expert analysis, or any position taken by Defendant.

I. DISCLOSURE OF ASSERTED CLAIMS AND PRELIMINARY INFRINGEMENT CONTENTIONS

A. Infringed Claims and Infringing Products

HPE commercialized the HP LoadRunner and HP Performance Center 11.50 offerings in 2012, with the follow up launch of HP LoadRunner and HP Performance Center 12.0 offerings for “Mobile and Cloud-based Application Testing” in March of 2014, including the subsequent release of HP StormRunner Load in September of 2014 as part of the HP Performance Testing Suite² and the follow up release of HP Mobile Center in October of 2014, among other additional mobile product offerings. After the HPE-Micro Focus spin-out merger, these product offerings were renamed using the term Micro Focus. Hereafter, these products are referred to as the “Micro Focus Software Suite.”

Defendant has been making and/or using (including for testing purposes) and continues to make and/or use (including for testing purposes) systems for testing an application for a mobile device, the systems for testing (“Micro Focus-related Accused Systems”) including, but not limited to, the Micro Focus Software Suite, which includes HP LoadRunner, HP Performance Center, HP StormRunner, HP Mobile Center, Shunra Network Virtualization, HP Network Virtualization engine, HP Network Virtualization for Mobile, HP Network Capture, and/or any Micro Focus products related to any of the foregoing.

Defendant through its making, using, and/or development of the Micro Focus-related Accused Systems has infringed and continues to infringe at least claims 1-3, 26, 37, and 45 of the ‘678 patent, claims 1-3, 8-12, 20, and 29 of the ‘864 patent, and claims 1-3 of the ‘192 patent.

In addition, Wapp believes that Defendant is infringing each of the three patents through its making, using, and/or development of additional products such as UI TestRunner

(“Additional Accused Systems”). However, because Wapp is in the process of seeking discovery about those additional products and infringement of these Additional Accused Systems involves applying software limitations, Wapp is presently unable to be more specific about where such limitations are met in the Additional Accused Systems. (*See* Patent Local Rule 3.1(g) as set out by Judge Mazzant in his Scheduling Order of November 1, 2019.) Based on the present information, Wapp believes that Defendant’s making, using, and/or development of the Additional Accused Systems may infringe each of claims 1-50 of the ‘678 patent, claims 1-41 of the ‘864 patent, and claims 1-16 and 60-69 of the ‘192 patent.

Wapp reserves the right to add, delete, substitute, or otherwise amend and/or supplement this identification of asserted claims should further discovery, the Court’s claim construction, or other circumstances so merit. Wapp further reserves the right to amend the attached charts, as well as other information contained in this document and the attachments hereto, to incorporate new information learned during the course of discovery.

B. Claim Charts

Wapp’s detailed preliminary infringement assertions for the Micro Focus-Related Accused Systems are contained in the claim charts provided as Attachment 1.

Attached as Attachment 2 are Wapp’s preliminary infringement assertions for the Additional Accused Systems.

Wapp further reserves the right to amend the claim charts, as well as other information contained in this document and the attachment hereto, pursuant to Patent Local Rule 3-6.

C. Doctrine of Equivalents

Wapp asserts that, under the proper construction of the asserted claims and their claim terms, the limitations of the asserted claims of the Wapp patents are literally present in the

Micro Focus-Related Accused Systems and the Additional Accused Systems, as set forth in the claim charts attached hereto. For any limitation that is found to be not literally present, Wapp asserts that Defendant induces and/or contributes to infringement by others and/or that such limitation is present under the doctrine of equivalents. At present, Wapp lacks knowledge as to which, if any, limitations of the asserted claims Defendant believes not to be literally embodied by the Micro Focus-Related Accused Systems and the Additional Accused Systems and, hence, as to whether Wapp will be contending that any limitations of the asserted claims (and, if so, which ones) are equivalently embodied by those systems.

Moreover, pursuant to Patent Local Rule 3-6, Wapp reserves the right to amend its Infringement Contentions to specifically assert infringement by the doctrine of equivalents in light of the Court's claim construction.

D. Priority Claim to an Earlier Application

The '678 patent claims priority to at least the following applications: U.S. Patent Application Ser. No. 13/673,692, filed November 9, 2012 (now U.S. Pat. No. 8,924,192), which is a continuation of U.S. Patent Application Ser. No. 12/759,543, filed April 13, 2010 (now U.S. Pat. No. 8,332,203), which is a continuation of U.S. Patent Application Ser. No. 11/449,958, filed June 9, 2006 (now U.S. Pat. No. 7,813,910) which claims priority to U.S. Patent Application Ser. No. 60/689,101, filed June 10, 2005.

The '864 patent claims priority to at least the following applications: U.S. Patent Application Ser. No. 12/705,913, filed February 15, 2010 (now U.S. Pat. No. 8,589,140), which claims priority to United States Application Ser. No. 61/152,934, filed Feb. 16, 2009, and is a continuation-in-part of United States Ser. No. 11/449,958, filed June 9, 2006 (now U.S. Pat. No. 7,813,910), which claims priority to United states Application Ser. No. 60/689,101, filed June 10, 2005.

The '192 patent claims priority to at least the following applications: U.S. Patent Application Ser. No. 12/759,543, filed April 13, 2010, which is a continuation of United States Patent Application Ser. No. 11/449,958, filed June 9, 2006 (now U.S. Pat. No. 7,813,910), which claims priority to U.S. Patent Application Ser. No. 60/689,101, filed June 10, 2005.

E. Practice of the Claimed Invention

Wapp does not contend that it practices the asserted claims of the asserted patent.

II. DOCUMENT PRODUCTION

A. Disclosure Prior to Application Date

Wapp will permit inspection and copying of, or shall otherwise produce, at a mutually convenient time documents in its possession, custody, and control pertaining to the disclosure to, or other manner of providing to a third party, or sale of or offer to sell the claimed inventions prior to the dates of application for the patents in suit at an agreed time and once the parties have concluded discussions as to an appropriately-modified Protective Order in this action.

B. Conception and Reduction to Practice

Wapp will permit inspection and copying of, or shall otherwise produce, at a mutually convenient time documents in its possession, custody, and control evidencing the conception, reduction to practice, design, and development of each claimed invention that were created on or before the relevant priority date identified above at an agreed time and once the parties have concluded discussions as to an appropriately-modified Protective Order in this action.

C. File History for Patents-In-Suit

Wapp will permit inspection and copying of, or shall otherwise produce, the patent file histories for the '678, '864, and '192 patents at a mutually convenient time.

Dated: November 7, 2019

DEVLIN LAW FIRM, LLC

/s/ Henrik D. Parker

Timothy Devlin

Henrik D. Parker

DEVLIN LAW FIRM LLC

1526 Gilpin Ave

Wilmington, DE 19806

(302) 449-9010

tdevlin@devlinlawfirm.com

hparker@devlinlawfirm.com

Jeffrey G. Toler

Texas State Bar No. 24011201

TOLER LAW GROUP, PC

8500 Bluffstone Cove, Suite A201

Austin, TX 78759

(512) 327-5515

jtoler@tlgiplaw.com

ATTORNEYS FOR PLAINTIFFS

WAPP TECH LIMITED PARTNERSHIP

AND WAPP TECH CORP

CERTIFICATE OF SERVICE

I hereby certify that on November 7, 2019, I caused a copy of this document to be served by transmitting it via e-mail or electronic transmission to counsel of record for Defendant.

/s/ Henrik D. Parker

Henrik D. Parker

EXHIBIT 1



BANK OF AMERICA

Claim 1, U.S. Pat. No. 8,924,192

Claim Element	Evidence of Infringement
<p>1. A system for developing an application for a mobile device comprising:</p>	<p>Each Micro Focus-related Accused System (which includes HP LoadRunner, HP Performance Center, HP StormRunner, HP Mobile Center, Shunra Network Virtualization, HP Network Virtualization engine, HP Network Virtualization for Mobile, HP Network Capture, and/or any Micro Focus products related to any of the foregoing) meets the elements of this claim (individually or collectively the “Micro Focus-related Infringing Products”). Please note that “HP”, “HPE” and “Micro Focus” are used interchangeably herein.</p> <p>“HP LoadRunner and HP Performance Center with Shunra Network Virtualization</p> <p>Improve the performance of mobile apps through effective testing...Shunra Network Virtualization, which integrates seamlessly into HP LoadRunner or Performance Center, enhances test accuracy by incorporating real-world network conditions into the load and performance test environment, ensuring that the test results are more reliable and accurate... The combination of HP LoadRunner or Performance Center and Shunra Network Virtualization is the path to robust, reliable, and accurate mobile performance testing.”</p> <p>HP LoadRunner and HP Performance Center with Shunra Network Virtualization, Page 1-3, Ex. A.</p> <p>“Built on the HP Network Virtualization engine, HP Network Virtualization for Mobile bridges the gap between development and deployment by enabling your mobile application development team to fully and accurately assess the behavior and impact of the network on mobile apps before they are introduced to end users. By virtualizing real-world mobile network conditions within testing environments, your test results are more reliably predictive of how an application will behave for end users.”</p> <p>HP Network Virtualization for Mobile, Page 2, Ex. B.</p> <p>The annotated image below illustrates the user interface for the LoadRunner platform, a system for developing an application for a mobile device.</p>

Claim 1, U.S. Pat. No. 8,924,192



a software authoring interface configured to simultaneously visually emulate, via one or more profile display windows, a plurality of network characteristics indicative of performance of the mobile device when executing the application;

Each Micro Focus-related Accused System is further configured to include a software authoring interface [e.g., the LoadRunner interface] configured to simultaneously visually simulate, via one or more profile display windows [e.g., the window highlighted in green in the annotated image below], a plurality of network characteristics [e.g., communication technology such as 2.5G, 3.5G, WiFi, etc.] indicative of performance of the mobile device when executing the application [e.g., the communication technology corresponds to bandwidth availability indicative of performance]. Communication technology options are shown in the highlighted green box in the annotated image below.

Claim 1, U.S. Pat. No. 8,924,192

“HP Network Virtualization for Mobile allows tests to be managed and results analyzed from any laptop or Wi-Fi-connected mobile device. The software can import **real-world mobile network profiles** captured by HP Network Capture or provided by the HP Network Virtualization Library of mobile and broadband network conditions.”

HP Network Virtualization for Mobile, Page 2, Ex. B.

“Because mobile network conditions are dynamic and vary by carrier, location, and time of day, it is essential for testing environments to accurately recreate multiple mobile network scenarios in order to analyze app performance and determine how network conditions affect different mobile users. The multi-flow capability in HP Network Virtualization for Mobile allows you to define a mobile test scenario that simultaneously emulates multiple user locations, each with its own unique set of virtualized mobile network conditions.”

HP Network Virtualization for Mobile, Page 4, Ex. B.

As illustrated below, each of the communication technology options has a corresponding network profile, which include a plurality of network characteristics.

“**Network Profiles . . . Profiles define the conditions for the test.** They can be based on Shunra’s™ Global Library recordings, or can be set manually. . . . The imported **profiles** are **recordings of mobile conditions between two points**. These recording files are stored in the Shunra Global Library which is a regularly updated, pre-populated set of more than 15 million recorded real-world data points of **point-to-point network conditions** recorded around the world. . . . You can manually define specific network conditions for an individual test and then save the **Profile** to be used in other tests.

To import a **Profile**:

- 1 In the **Network Profiles tab** the following general profiles are displayed (these profiles are already imported and do not require Internet access):

Claim 1, U.S. Pat. No. 8,924,192

3G: latency 75 ms, download 780 Kbps, upload 330 Kbps, packet loss 0%
 Edge: latency 200 ms, download 100 Kbps, upload 100 Kbps, packet loss 0%
 LTE: latency 40ms, download 10,000 Kbps, upload 7500 Kbps, packet loss 0%
 DSL: latency 25ms, download 2000 Kbps, upload 256 Kbps, packet loss 0%
 100% Loss: latency 0 ms, download 10000 Kbps, upload 10000 Kbps, packet loss 100%
 Very Bad Network: latency 500 ms, download 1000 Kbps, upload 1000 Kbps, packet loss 10%”

**HP Network Virtualization for Mobile, Shunra vCat for Mobile Manual, Pages 19-20, Ex. C.**

“HP Network Virtualization for Mobile is the only network virtualization solution designed specifically for the unique requirements of mobile app testing. Based on technology acquired from Shunra, this field-proven HP solution reduces the risk of poor mobile performance and helps your organization test, validate, and optimize the performance of your mobile apps before deployment.”

HP Network Virtualization for Mobile, Page 1, Ex. B.

“Built on the HP Network Virtualization engine, HP Network Virtualization for Mobile bridges the gap between development and deployment by enabling your mobile application development team to fully and accurately assess the behavior and impact of the network on mobile apps before they are introduced to end users. By virtualizing real-world mobile network conditions within testing environments, your test results are more reliably predictive of how an application will behave for end users.”

HP Network Virtualization for Mobile, Page 2, Ex. B.

Claim 1, U.S. Pat. No. 8,924,192

wherein the software authoring interface is further configured to simulate a network connection state encountered by the mobile device.

“Network Profiles . . . Profiles define the conditions for the test. They can be based on Shunra’s™ Global Library recordings, or can be set manually. . . . The imported profiles are recordings of mobile conditions between two points. These recording files are stored in the Shunra Global Library which is a regularly updated, pre-populated set of more than 15 million recorded real-world data points of point-to-point network conditions recorded around the world. . . . You can manually define specific network conditions for an individual test and then save the Profile to be used in other tests.”

HP Network Virtualization for Mobile, Shunra vCat for Mobile Manual, Page 19, Ex. C.

The screenshot displays a configuration interface for network virtualization. At the top, there are three tabs: '1 From - To Tel Aviv, Israel - Tokyo, Japan', '2 Connection Properties' (which is active and highlighted in blue), and '3'. Below the tabs, there is a section titled 'All Technologies, Carriers, Times'. Under this section, there are three columns: 'Technology', 'Carrier', and 'Time'. The 'Technology' column has a dropdown menu with options: 'WiFi', '3G', '2.75G', '3.5G', and '2.5G'. The 'Carrier' column has a dropdown menu with options: 'Other' and 'Orange'. The 'Time' column has a dropdown menu with options: 'off work' and 'work'.

Network
Virtualization
Network Performance
Testing

Capture and emulate real-world network conditions, so you can execute network performance testing to detect and remediate issues before app deployment.

Discover and capture

Discover and capture live network performance conditions—such as latency, packet loss, bandwidth limitation and jitter—and recreate those conditions for network performance testing.”

Claim 1, U.S. Pat. No. 8,924,192

Micro Focus Network Virtualization Website, available at <https://software.microfocus.com/en-us/products/network-virtualization-for-load-testing/overview>

“Network Virtualization software allows you to discover and capture real-world network performance conditions from your production network, recreate network conditions in your lab during application testing, and optimize the applications to improve performance before you deploy into production.”

Micro Focus Network Virtualization Data Sheet, Page 1, Ex. D.

“Use Network Capture to record and identify application performance problems occurring at a remote location, by measuring network conditions such as latency, packet loss, bandwidth availability across any given network topology. Network Capture can measure production links around the globe for a duration of up to one month.”

HP Network Capture User Guide, Page 6, Ex. E.

“HP LoadRunner and HP Performance Center mobile testing protocols enable comprehensive performance testing of mobile applications for most mobile platforms—Android, iPhone®, Windows®, and others. Using the mobile protocols, the performance testing team is able to capture mobile traffic and generate realistic mobile load on the system under test.

Features and benefits

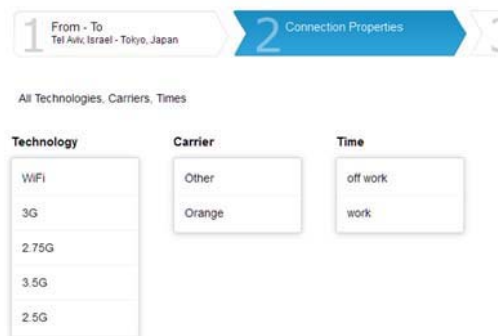
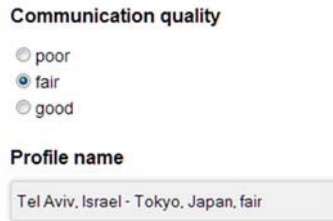
Shunra Network Virtualization enables an effective engineering methodology for application performance, providing the capabilities to discover real-world network conditions, virtualize those conditions in the test environment, analyze test results to isolate potential bottlenecks, and automatically deliver custom performance optimization recommendations. It provides:

NetworkCatcher: The ability to automatically gather real-world network conditions, collecting interval statistics that include bidirectional bandwidth, latency, jitter, and packet loss conditions.

Global Library: Access to Shunra’s Global Library of mobile and broadband conditions provides up-to-date average, best-case, and worst-case network conditions from thousands of cities worldwide.”

HP LoadRunner and HP Performance Center with Shunra Network Virtualization, Page 1-3, Ex. A.

Claim 2, U.S. Pat. No. 8,924,192

Claim Element	Evidence of Infringement
<p>2. The system of claim 1, wherein the software authoring interface is configured to enable a user to select from one or more connection simulations for testing how well mobile content performs on the mobile device.</p>	<p>Each Micro Focus-related Accused System is further configured to enable a user to select from one or more network conditions for testing the mobile application.</p> <p>“In the Connection Properties, define the Technology, Carrier and Time of day.</p> <p>Note: The Technology and Carrier are related to the Client Location.</p>  <p>Select the forward arrows and choose one of the Communication quality options. If a WiFi connection was selected, select the required bandwidth.”</p>  <p>HP Network Virtualization for Mobile, Shunra vCat for Mobile Manual, Page 20-21, Ex. C.</p> <p>“Because mobile network conditions are dynamic and vary by carrier, location, and time of day, it is</p>

Claim 2, U.S. Pat. No. 8,924,192

essential for testing environments to accurately recreate multiple mobile network scenarios in order to analyze app performance and determine how network conditions affect different mobile users. The multi-flow capability in HP Network Virtualization for Mobile allows you to define a mobile test scenario that simultaneously emulates multiple user locations, each with its own unique set of virtualized mobile network conditions.”

HP Network Virtualization for Mobile, Page 4, Ex. B.

“Micro Focus Network Virtualization Network Performance Testing

Capture and emulate real-world network conditions, so you can execute network performance testing to detect and remediate issues before app deployment.

Discover and capture

Discover and capture live network performance conditions—such as latency, packet loss, bandwidth limitation and jitter—and recreate those conditions for network performance testing.”

Micro Focus Corporate Website, available at <https://software.microfocus.com/en-us/products/network-virtualization-for-load-testing/overview>.

“Network Virtualization software allows you to discover and capture real-world network performance conditions from your production network, recreate network conditions in your lab during application testing, and optimize the applications to improve performance before you deploy into production.”

Micro Focus Network Virtualization Data Sheet, Page 1, Ex. D.

“Network Profiles

Profiles define the conditions for the test. They can be based on Shunra’s™ Global Library recordings, or can be set manually.

Claim 2, U.S. Pat. No. 8,924,192

The imported profiles are recordings of mobile conditions between two points. These recording files are stored in the Shunra Global Library which is a regularly updated, pre-populated set of more than 15 million recorded real-world data points of point-to-point network conditions recorded around the world.”

HP Network Virtualization for Mobile, Shunra vCat for Mobile Manual, Page 19, Ex. C.

“Use Network Capture to record and identify application performance problems occurring at a remote location, by measuring network conditions such as latency, packet loss, bandwidth availability across any given network topology. Network Capture can measure production links around the globe for a duration of up to one month.”

HP Network Capture User Guide, Page 6, Ex. E.

“HP LoadRunner and HP Performance Center mobile testing protocols enable comprehensive performance testing of mobile applications for most mobile platforms—Android, iPhone®, Windows®, and others. Using the mobile protocols, the performance testing team is able to capture mobile traffic and generate realistic mobile load on the system under test.

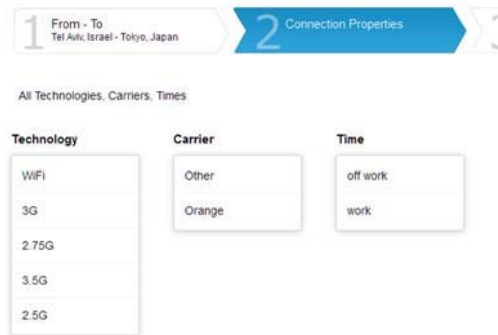
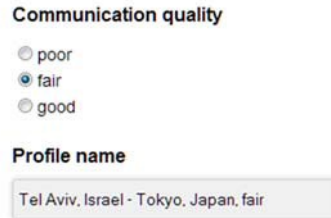
Features and benefits...

Shunra Network Virtualization enables an effective engineering methodology for application performance, providing the capabilities to discover real-world network conditions, virtualize those conditions in the test environment, analyze test results to isolate potential bottlenecks, and automatically deliver custom performance optimization recommendations. It provides:

NetworkCatcher: The ability to automatically gather real-world network conditions, collecting interval statistics that include bidirectional bandwidth, latency, jitter, and packet loss conditions

Global Library: Access to Shunra’s Global Library of mobile and broadband conditions provides up-to-date average, best-case, and worst-case network conditions from thousands of cities worldwide.”

Claim 3, U.S. Pat. No. 8,924,192

Claim Element	Evidence of Infringement
<p>3. The system of claim 2, wherein the one or more connection simulations are configured to simulate wireless transmission of content to the mobile device based on the selected connection simulation.</p>	<p>HP LoadRunner and HP Performance Center with Shunra Network Virtualization, Page 2-3, Ex. A.</p> <p>Each Micro Focus-related Accused System is further configured to enable a user to select from one or more network conditions for testing the mobile application.</p> <p>“In the Connection Properties, define the Technology, Carrier and Time of day.</p> <p>Note: The Technology and Carrier are related to the Client Location.</p>  <p>Select the forward arrows and choose one of the Communication quality options. If a WiFi connection was selected, select the required bandwidth.”</p>  <p>HP Network Virtualization for Mobile, Shunra vCat for Mobile Manual, Page 20-21, Ex. C.</p>

Claim 3, U.S. Pat. No. 8,924,192

“Because mobile network conditions are dynamic and vary by carrier, location, and time of day, it is essential for testing environments to accurately recreate multiple mobile network scenarios in order to analyze app performance and determine how network conditions affect different mobile users. The multi-flow capability in HP Network Virtualization for Mobile allows you to define a mobile test scenario that simultaneously emulates multiple user locations, each with its own unique set of virtualized mobile network conditions.”

HP Network Virtualization for Mobile, Page 4, Ex. B.

“Micro Focus Network Virtualization Network Performance Testing

Capture and emulate real-world network conditions, so you can execute network performance testing to detect and remediate issues before app deployment.

Discover and capture

Discover and capture live network performance conditions—such as latency, packet loss, bandwidth limitation and jitter—and recreate those conditions for network performance testing.”

Micro Focus Corporate Website, available at <https://software.microfocus.com/en-us/products/network-virtualization-for-load-testing/overview>.

“Network Virtualization software allows you to discover and capture real-world network performance conditions from your production network, recreate network conditions in your lab during application testing, and optimize the applications to improve performance before you deploy into production.”

Micro Focus Network Virtualization Data Sheet, Page 1, Ex. D.

Claim 3, U.S. Pat. No. 8,924,192

The imported profiles are recordings of mobile conditions between two points. These recording files are stored in the Shunra Global Library which is a regularly updated, pre-populated set of more than 15 million recorded real-world data points of point-to-point network conditions recorded around the world.”

HP Network Virtualization for Mobile, Shunra vCat for Mobile Manual, Page 19, Ex. C.

“Use Network Capture to record and identify application performance problems occurring at a remote location, by measuring network conditions such as latency, packet loss, bandwidth availability across any given network topology. Network Capture can measure production links around the globe for a duration of up to one month.”

HP Network Capture User Guide, Page 6, Ex. E.

“HP LoadRunner and HP Performance Center mobile testing protocols enable comprehensive performance testing of mobile applications for most mobile platforms—Android, iPhone®, Windows®, and others. Using the mobile protocols, the performance testing team is able to capture mobile traffic and generate realistic mobile load on the system under test.

Features and benefits...

Shunra Network Virtualization enables an effective engineering methodology for application performance, providing the capabilities to discover real-world network conditions, virtualize those conditions in the test environment, analyze test results to isolate potential bottlenecks, and automatically deliver custom performance optimization recommendations. It provides:

NetworkCatcher: The ability to automatically gather real-world network conditions, collecting interval statistics that include bidirectional bandwidth, latency, jitter, and packet loss conditions

Global Library: Access to Shunra’s Global Library of mobile and broadband conditions provides up- to-date average, best-case, and worst-case network conditions from thousands of cities worldwide.”

HP LoadRunner and HP Performance Center with Shunra Network Virtualization, Page 2-3, Ex. A.

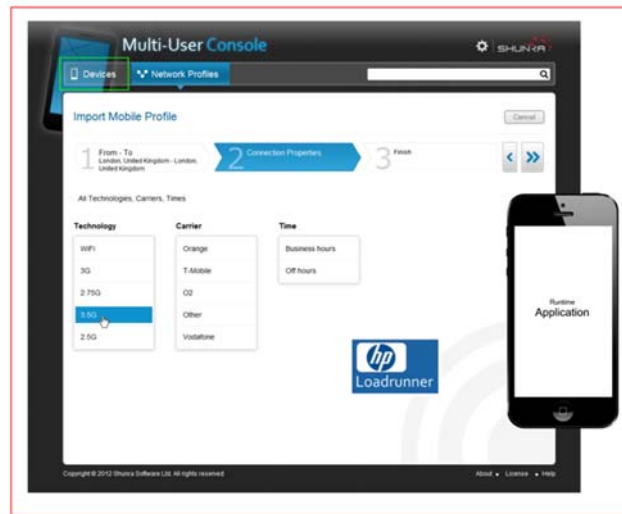


BANK OF AMERICA

Claim 1, U.S. Pat. No. 9,298,864

Claim Element	Evidence of Infringement
<p>1. A system for testing an application for a mobile device comprising:</p>	<p>Each Micro Focus-related Accused System (which includes HP LoadRunner, HP Performance Center, HP StormRunner, HP Mobile Center, Shunra Network Virtualization, HP Network Virtualization engine, HP Network Virtualization for Mobile, HP Network Capture, and/or any Micro Focus products related to any of the foregoing) meets the elements of this claim (individually or collectively the “Micro Focus-related Infringing Products”). Please note that “HP”, “HPE” and “Micro Focus” are used interchangeably herein.</p> <p>“HP LoadRunner and HP Performance Center with Shunra Network Virtualization</p> <p>Improve the performance of mobile apps through effective testing...Shunra Network Virtualization, which integrates seamlessly into HP LoadRunner or Performance Center, enhances test accuracy by incorporating real-world network conditions into the load and performance test environment, ensuring that the test results are more reliable and accurate...The combination of HP LoadRunner or Performance Center and Shunra Network Virtualization is the path to robust, reliable, and accurate mobile performance testing.”</p> <p>HP LoadRunner and HP Performance Center with Shunra Network Virtualization, Page 1-3, Ex. A.</p> <p>“Built on the HP Network Virtualization engine, HP Network Virtualization for Mobile bridges the gap between development and deployment by enabling your mobile application development team to fully and accurately assess the behavior and impact of the network on mobile apps before they are introduced to end users. By virtualizing real-world mobile network conditions within testing environments, your test results are more reliably predictive of how an application will behave for end users.”</p> <p>HP Network Virtualization for Mobile, Page 2, Ex. B.</p> <p>The annotated image below illustrates the user interface for the LoadRunner platform, a system for testing an application for a mobile device.</p>

Claim 1, U.S. Pat. No. 9,298,864



software configured to simulate, via one or more profile display windows, a plurality of network characteristics indicative of performance of the mobile device when executing the application;

Each Micro Focus-related Accused System is further configured to include software [e.g., LoadRunner] configured to simultaneously visually simulate, via one or more profile display windows [e.g., the window highlighted in green in the annotated image below], a plurality of operator network characteristics [e.g., communication technology such as 2.5G, 3.5G, WiFi, etc.] indicative of performance [e.g., the communication technology corresponds to bandwidth availability indicative of performance] of the mobile device when executing the application. Communication technology options are shown in the highlighted green box in the annotated image below.

Claim 1, U.S. Pat. No. 9,298,864

“HP Network Virtualization for Mobile allows tests to be managed and results analyzed from any laptop or Wi-Fi-connected mobile device. The software can import **real-world mobile network profiles** captured by HP Network Capture or provided by the HP Network Virtualization Library of mobile and broadband network conditions.”

HP Network Virtualization for Mobile, Page 2, Ex. B.

“Because mobile network conditions are dynamic and vary by carrier, location, and time of day, it is essential for testing environments to accurately recreate multiple mobile network scenarios in order to analyze app performance and determine how network conditions affect different mobile users. The multi-flow capability in HP Network Virtualization for Mobile allows you to define a mobile test scenario that simultaneously emulates multiple user locations, each with its own unique set of virtualized mobile network conditions.”

HP Network Virtualization for Mobile, Page 4, Ex. B.

As illustrated below, each of the communication technology options has a corresponding network profile, which include a plurality of network characteristics.

“**Network Profiles . . . Profiles define the conditions for the test.** They can be based on Shunra’s™ Global Library recordings, or can be set manually. . . . The imported **profiles** are **recordings of mobile conditions between two points**. These recording files are stored in the Shunra Global Library which is a regularly updated, pre-populated set of more than 15 million recorded real-world data points of **point-to-point network conditions** recorded around the world. . . . You can manually define specific

Claim 1, U.S. Pat. No. 9,298,864

network conditions for an individual test and then save the **Profile** to be used in other tests.

To import a **Profile**:

1 In the **Network Profiles** tab the following general profiles are displayed (these profiles are already imported and do not require Internet access):

3G: latency 75 ms, download 780 Kbps, upload 330 Kbps, packet loss 0%

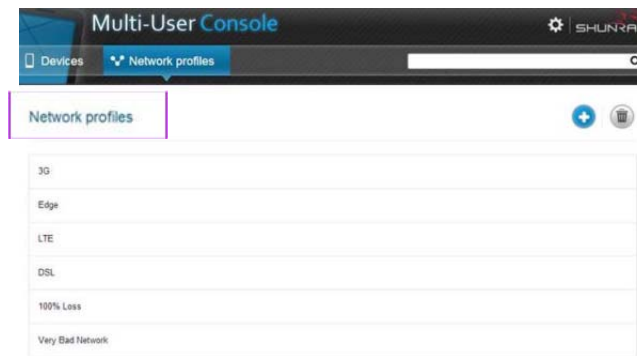
Edge: latency 200 ms, download 100 Kbps, upload 100 Kbps, packet loss 0%

LTE: latency 40ms, download 10,000 Kbps, upload 7500 Kbps, packet loss 0%

DSL: latency 25ms, download 2000 Kbps, upload 256 Kbps, packet loss 0%

100% Loss: latency 0 ms, download 10000 Kbps, upload 10000 Kbps, packet loss 100%

Very Bad Network: latency 500 ms, download 1000 Kbps, upload 1000 Kbps, packet loss 10%”



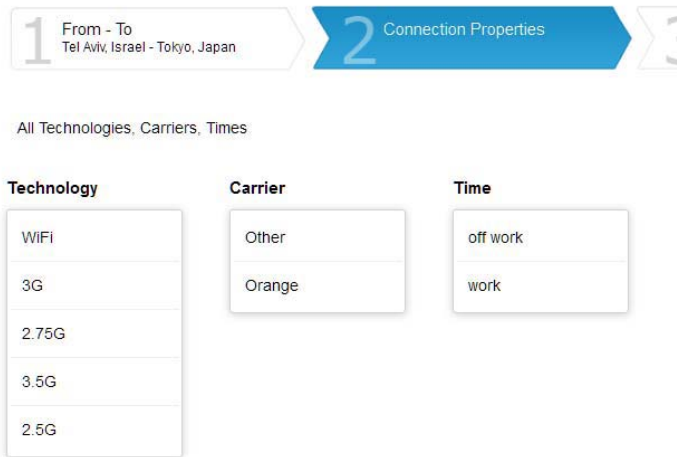
HP Network Virtualization for Mobile, Shunra vCat for Mobile Manual, Pages 19-20, Ex. C.

“HP Network Virtualization for Mobile is the only network virtualization solution designed specifically for the unique requirements of mobile app testing. Based on technology acquired from Shunra, this field-proven HP solution reduces the risk of poor mobile performance and helps your organization test, validate, and optimize the performance of your mobile apps before deployment.”

HP Network Virtualization for Mobile, Page 1, Ex. B.

“Built on the HP Network Virtualization engine, HP Network Virtualization for Mobile bridges the gap between development and deployment by enabling your mobile application development team to fully and accurately assess the behavior and impact of the network on mobile apps before they are introduced to end users. By virtualizing real-world mobile network conditions within testing

Claim 1, U.S. Pat. No. 9,298,864

	<p>environments, your test results are more reliably predictive of how an application will behave for end users.”</p> <p>HP Network Virtualization for Mobile, Page 2, Ex. B.</p>
<p>wherein the network characteristics are based on data of interaction with networks in non-simulated environments.</p>	<p>“Network Profiles . . . Profiles define the conditions for the test. They can be based on Shunra’s™ Global Library recordings, or can be set manually. . . . The imported profiles are recordings of mobile conditions between two points. These recording files are stored in the Shunra Global Library which is a regularly updated, pre-populated set of more than 15 million recorded real-world data points of point-to-point network conditions recorded around the world. . . . You can manually define specific network conditions for an individual test and then save the Profile to be used in other tests.”</p> <p>HP Network Virtualization for Mobile, Shunra vCat for Mobile Manual, Page 19, Ex. C.</p>  <p>“Micro Focus Network Virtualization Network Performance Testing</p> <p>Capture and emulate real-world network conditions, so you can execute network performance testing to detect and remediate issues before app deployment.</p>

Claim 1, U.S. Pat. No. 9,298,864**Discover and capture**

Discover and capture live network performance conditions—such as latency, packet loss, bandwidth limitation and jitter—and recreate those conditions for network performance testing.”

Micro Focus Network Virtualization Website, available at <https://software.microfocus.com/en-us/products/network-virtualization-for-load-testing/overview>

“Network Virtualization software allows you to discover and capture real-world network performance conditions from your production network, recreate network conditions in your lab during application testing, and optimize the applications to improve performance before you deploy into production.”

Micro Focus Network Virtualization Data Sheet, Page 1, Ex. D.

“Use Network Capture to record and identify application performance problems occurring at a remote location, by measuring network conditions such as latency, packet loss, bandwidth availability across any given network topology. Network Capture can measure production links around the globe for a duration of up to one month.”

HP Network Capture User Guide, Page 6, Ex. E.

“HP LoadRunner and HP Performance Center mobile testing protocols enable comprehensive performance testing of mobile applications for most mobile platforms—Android, iPhone®, Windows®, and others. Using the mobile protocols, the performance testing team is able to capture mobile traffic and generate realistic mobile load on the system under test.

Features and benefits...

Shunra Network Virtualization enables an effective engineering methodology for application performance, providing the capabilities to discover real-world network conditions, virtualize those conditions in the test environment, analyze test results to isolate potential bottlenecks, and automatically deliver custom performance optimization recommendations. It provides:

NetworkCatcher: The ability to automatically gather real-world network conditions, collecting interval statistics that include bidirectional bandwidth, latency, jitter, and packet loss conditions

Claim 1, U.S. Pat. No. 9,298,864

	<p>Global Library: Access to Shunra’s Global Library of mobile and broadband conditions provides up-to-date average, best-case, and worst-case network conditions from thousands of cities worldwide.”</p> <p>HP LoadRunner and HP Performance Center with Shunra Network Virtualization, Page 2-3, Ex. A.</p>
--	---

Claim 2, U.S. Pat. No. 9,298,864

Claim Element	Evidence of Infringement
<p>2. The system of claim 1, wherein the software is further configured to capture network profiles from a plurality of geographical locations.</p>	<p>Each Micro Focus-related Accused System is further configured to enable a user to select from one or more network conditions for testing the mobile application.</p> <p>“Micro Focus Network Virtualization Network Performance Testing</p> <p>Capture and emulate real-world network conditions, so you can execute network performance testing to detect and remediate issues before app deployment.</p> <p>Discover and capture</p> <p>Discover and capture live network performance conditions—such as latency, packet loss, bandwidth limitation and jitter—and recreate those conditions for network performance testing.”</p> <p>Micro Focus Network Virtualization Website, available at https://software.microfocus.com/en-us/products/network-virtualization-for-load-testing/overview.</p> <p>“Network Virtualization software allows you to discover and capture real-world network performance conditions from your production network, recreate network conditions in your lab during application testing, and optimize the applications to improve performance before you deploy into production.”</p> <p>Micro Focus Network Virtualization Data Sheet, Page 1, Ex. D.</p> <p>“Network Profiles</p> <p>Profiles define the conditions for the test. They can be based on Shunra’s™ Global Library recordings, or can be set manually.</p> <p>The imported profiles are recordings of mobile conditions between two points. These recording files are stored in the Shunra Global Library which is a regularly updated, pre-populated set of more than 15 million recorded real-world data points of point-to-point network conditions recorded around the world.”</p> <p>HP Network Virtualization for Mobile, Shunra vCat for Mobile Manual, Page 19, Ex. C.</p> <p>“Use Network Capture to record and identify application performance problems occurring at a remote</p>

Claim 2, U.S. Pat. No. 9,298,864

location, by measuring network conditions such as latency, packet loss, bandwidth availability across any given network topology. Network Capture can measure production links around the globe for a duration of up to one month.”

HP Network Capture User Guide, Page 6, Ex. E.

“HP LoadRunner and HP Performance Center mobile testing protocols enable comprehensive performance testing of mobile applications for most mobile platforms—Android, iPhone®, Windows®, and others. Using the mobile protocols, the performance testing team is able to capture mobile traffic and generate realistic mobile load on the system under test.

Features and benefits...

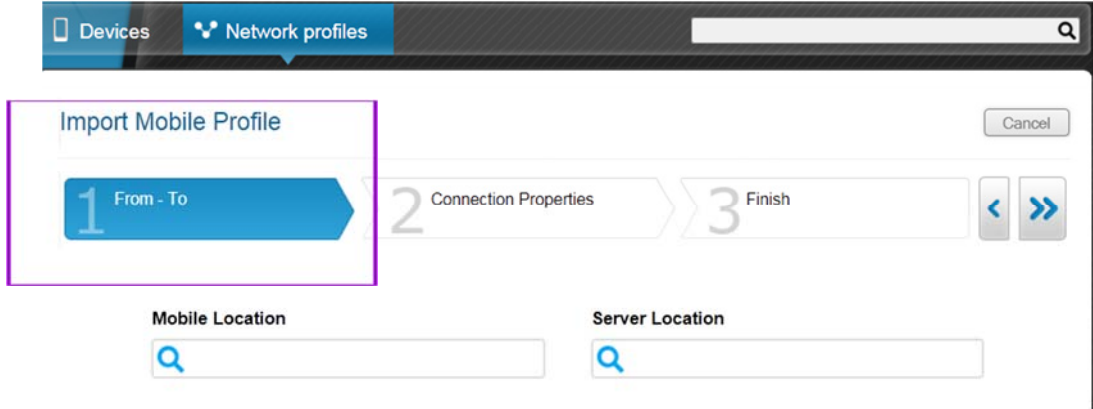
Shunra Network Virtualization enables an effective engineering methodology for application performance, providing the capabilities to discover real-world network conditions, virtualize those conditions in the test environment, analyze test results to isolate potential bottlenecks, and automatically deliver custom performance optimization recommendations. It provides:

NetworkCatcher: The ability to automatically gather real-world network conditions, collecting interval statistics that include bidirectional bandwidth, latency, jitter, and packet loss conditions

Global Library: Access to Shunra’s Global Library of mobile and broadband conditions provides up-to-date average, best-case, and worst-case network conditions from thousands of cities worldwide.”

HP LoadRunner and HP Performance Center with Shunra Network Virtualization, Page 2-3, Ex. A.

Claim 3, U.S. Pat. No. 9,298,864

Claim Element	Evidence of Infringement
<p>3. The system of claim 2, wherein the network profiles can either be saved in a storage medium, or stored on a server, or both.</p>	<p>As illustrated below, the network profiles can be saved on a storage medium [e.g., MySQL] or on a server.</p> <p>“Network Profiles</p> <p>Profiles define the conditions for the test. They can be based on Shunra’s™ Global Library recordings, or can be set manually.</p> <p>The imported profiles are recordings of mobile conditions between two points. These recording files are stored in the Shunra Global Library which is a regularly updated, pre-populated set of more than 15 million recorded real-world data points of point-to-point network conditions recorded around the world.”</p> <p>HP Network Virtualization for Mobile, Shunra vCat for Mobile Manual, Page 19, Ex. C.</p> <p>In the From-To, select the Mobile and Server locations, such as the name of a city or state.”</p>  <p>HP Network Virtualization for Mobile, Shunra vCat for Mobile Manual, Page 19-20, Ex. C.</p> <p>“APE — Best Practices</p>

Claim 3, U.S. Pat. No. 9,298,864

	<p>Discovery: identify and record real-world infrastructure and network conditions, business processes, application topology and deployment scenarios.</p> <p>Pre-recorded library of global mobile and broadband network profiles enables rapid testing of mobile applications.</p> <p>Pre-recorded network profiles for emulating typical mobile and broadband network conditions between major global cities.”</p> <p>Built-in MySQL database stores thousands of network profiles.”</p> <p>Shunra NetworkCatcher, Page 2, Ex. F.</p>
--	--

Claim 8, U.S. Pat. No. 9,298,864

Claim Element	Evidence of Infringement
<p>8. The system of claim 1, wherein the software is further configured to create one or more scenarios that include scripts that impact either the performance of the application, or the network, or both.</p>	<p>Each Micro Focus-related Accused System is further configured to create one or more scenarios that include scripts for testing the application.</p> <p>“Because mobile network conditions are dynamic and vary by carrier, location, and time of day, it is essential for testing environments to accurately recreate multiple mobile network scenarios in order to analyze app performance and determine how network conditions affect different mobile users. The multi-flow capability in HP Network Virtualization for Mobile allows you to define a mobile test scenario that simultaneously emulates multiple user locations, each with its own unique set of virtualized mobile network conditions.”</p> <p>HP Network Virtualization for Mobile, Page 4, Ex. B.</p> <p>“LoadRunner Terminology</p> <ul style="list-style-type: none"> • Scenario. A scenario is a sequence of events that emulate the hypothetical actions of real users on your application. • Vusers. In the scenario, LoadRunner replaces real users with virtual users or Vusers. While a workstation accommodates only a single human user, many Vusers can run concurrently on a single workstation. In fact, a scenario can contain tens, hundreds, or even thousands of Vusers. • Vuser Scripts. The actions that a Vuser performs during the scenario are described in a Vuser script. When you run a scenario, each Vuser executes a Vuser script. The Vuser scripts include functions that measure and record the performance of your application's components. • Controller. You use the LoadRunner Controller to manage and maintain your scenarios. Using the Controller, you control all the Vusers in a scenario from a single workstation. • Load Generator. When you execute a scenario, the Controller distributes each Vuser in the scenario to a load generator. The load generator is the machine that executes the Vuser script, enabling the Vuser to emulate the actions of a human user.

Claim 8, U.S. Pat. No. 9,298,864

- | | |
|--|--|
| | <ul style="list-style-type: none">• Performance analysis. Vuser scripts include functions that measure and record system performance during load-testing sessions. During a scenario run, you can monitor the network and server resources. Following a scenario run, you can view performance analysis data in reports and graphs.” |
|--|--|

Micro Focus LoadRunner Help Center, https://admhelp.microfocus.com/lr/en/12.56-12.57/help/WebHelp/Content/Controller/c_terms_lr.htm

Claim 9, U.S. Pat. No. 9,298,864

<p>9. The system of claim 8, wherein the one or more scenarios define one or more events that occur during the test which includes defining one or more virtual users to simulate real users.</p>	<p>Each Micro Focus-related Accused System is further configured to define one or more events during the test which includes defining one or more virtual users to simulate real users.</p> <p>“LoadRunner Terminology</p> <ul style="list-style-type: none"> • Scenario. A scenario is a sequence of events that emulate the hypothetical actions of real users on your application.” <p>Micro Focus LoadRunner Help Center, https://admhelp.microfocus.com/lr/en/12.56-12.57/help/WebHelp/Content/Controller/c_terms_lr.htm</p> <p>“Understanding the HP LoadRunner main components</p> <p>VuGen (Virtual User generator): In order to simulate transactions, it is necessary to create scripts for it. The HP LoadRunner scripting tool is called VuGen...Controller and Load Generator: Once transactions are ready to be simulated, you will need to create the user scenarios and execute them. The user scenarios will simulate the users’ behavior within the application. For example:</p> <p>The component to execute the transactions based on users’ behavior is called the controller. Using the controller, you can control all the virtual users (known as Vuser) in a scenario from a single workstation...Most of the Vuser operate as a single thread process, enabling a single server or computer to emulate the actions of if several 100 users.”</p> <p>Micro Focus LoadRunner Community Home, https://community.softwaregrp.com/t5/All-About-the-Apps/HP-LoadRunner-Where-do-I-start-VuGen/ba-p/303730#.WxmOD-4vwuV</p>
--	---

Claim 10, U.S. Pat. No. 9,298,864

<p>10. The system of claim 9, wherein the one or more virtual users emulate actions of real user behavior.</p>	<p>Each Micro Focus-related Accused System is further configured to define one or more events during the test which includes defining one or more virtual users to simulate real users.</p> <p>“LoadRunner Terminology</p> <ul style="list-style-type: none"> • Scenario. A scenario is a sequence of events that emulate the hypothetical actions of real users on your application.” <p>Micro Focus LoadRunner Help Center, https://admhelp.microfocus.com/lr/en/12.56-12.57/help/WebHelp/Content/Controller/c_terms_lr.htm</p> <p>“Understanding the HP LoadRunner main components</p> <p>The component to execute the transactions based on users’ behavior is called the controller. Using the controller, you can control all the virtual users (known as Vuser) in a scenario from a single workstation...Most of the Vuser operate as a single thread process, enabling a single server or computer to emulate the actions of if several 100 users.”</p> <p>Micro Focus LoadRunner Community Home, https://community.softwaregrp.com/t5/All-About-the-Apps/HP-LoadRunner-Where-do-I-start-VuGen/ba-p/303730#.WxmOD-4vwuV</p> <p>“After the recording, VuGen generates various functions that define the actions performed during the recording session. VuGen inserts these functions into the VuGen editor to create a basic Vuser script. Instead of having to manually program the application's API function calls to the server, VuGen automatically generates functions that model and emulate real world situations.”</p> <p>Micro Focus LoadRunner Help Center, https://admhelp.microfocus.com/lr/en/12.56-12.57/help/WebHelp/Content/VuGen/100050_c_vugen_overview.htm</p>
---	--

Claim 11, U.S. Pat. No. 9,298,864

<p>11. The system of claim 10, wherein the actions that are performed by one or more virtual users are recorded to generate a script which can be modified to emulate real user behavior.</p>	<p>Each Micro Focus-related Accused System is further configured to record the actions of one or more virtual users to generate a script to emulate real user behavior.</p> <p>“The Inside story on HPE LoadRunner</p> <p>With an intuitive record and playback mechanism, including the patented TruClient technology, HPE LoadRunner reproduces real business processes that a user would perform in production. These scripts can then be easily modified to emulate real user behavior.</p> <p>LoadRunner then emulates hundreds or thousands of concurrent virtual users, with minimal hardware, to apply accurate workloads to any application. By leveraging HPE Network Virtualization and HPE Service Virtualization, you can eliminate and control unknown variables and isolate performance risks.”</p> <p>HPE LoadRunner Data Sheet, http://www8.hp.com/us/en/software-solutions/loadrunner-load-testing/index/resource/hpe-loadrunner-data-sheet/2081333/</p> <p>“You use VuGen to develop a Vuser script by recording a user performing typical business processes on a client application. VuGen records the actions that you perform during the recording session, recording only the activity between the client and the server. During recording, VuGen monitors the client and traces all the requests sent to and received from the server.</p> <p>During recording, VuGen monitors the client and traces all the requests sent to and received from the server.”</p> <p>Micro Focus LoadRunner Help Center, https://admhelp.microfocus.com/lr/en/12.56-12.57/help/WebHelp/Content/VuGen/100050_c_vugen_overview.htm</p> <p>“After the recording, VuGen generates various functions that define the actions performed during the recording session. VuGen inserts these functions into the VuGen editor to create a basic Vuser script. Instead of having to manually program the application's API function calls to the server, VuGen automatically generates functions that model and emulate real world situations.”</p> <p>Micro Focus LoadRunner Help Center, https://admhelp.microfocus.com/lr/en/12.56-12.57/help/WebHelp/Content/VuGen/100050_c_vugen_overview.htm</p>
---	---

Claim 11, U.S. Pat. No. 9,298,864**“Mobile application testing**

HPE LoadRunner is the most complete solution for mobile application performance testing; including Mobile Web, Native and Hybrid applications. The **Mobile TruClient** protocol supports the rapid testing of browser-based mobile applications, and the **Mobile Applications** protocol provides support for **native, Web and Hybrid applications**. HPE solutions for **mobile testing** can be used to test mobile applications against any platform and OS. **HPE LoadRunner seamlessly integrates** with **Network Virtualization** enabling **realistic network conditions** during each test.

Mobile Application recording options

When it comes to Mobile testing, one method does not fit all. Whether you have access to a physical device, application or device emulator, or traffic capture from any available Mobile device cloud; the methods used for capturing application usage will vary with each deployment model. That is why HPE LoadRunner includes multiple methods for recording **Mobile application scripts**, to meet the needs of any Mobile development project. **Virtual User Generator** supports the following Mobile application **scripting methods**:

- Server-side traffic capture
- PCAP traffic recording
- **Mobile Device Emulator**
- Proxy recording
- **TruClient Mobile** (for mobile-web applications)

The **HPE LoadRunner Mobile Recorder** is also available on **Google Play** for capturing traffic directly on an **Android device**.”

HPE LoadRunner Data Sheet, <http://www8.hp.com/us/en/software-solutions/loadrunner-load-testing/index/resource/hpe-loadrunner-data-sheet/2081333/>

Claim 12, U.S. Pat. No. 9,298,864

<p>12. The system of claim 11, wherein the scripts include one or more functions that measure and record performance of either the application, or the network, or both.</p>	<p>Wherein the scripts include one or more functions that measure and record performance of either the application or the network.</p> <p>“LoadRunner Terminology</p> <ul style="list-style-type: none"> • Scenario. A scenario is a sequence of events that emulate the hypothetical actions of real users on your application. • Vuser Scripts. The actions that a Vuser performs during the scenario are described in a Vuser script. When you run a scenario, each Vuser executes a Vuser script. The Vuser scripts include functions that measure and record the performance of your application's components. • Performance analysis. Vuser scripts include functions that measure and record system performance during load-testing sessions. During a scenario run, you can monitor the network and server resources. Following a scenario run, you can view performance analysis data in reports and graphs.” <p>Micro Focus LoadRunner Help Center, https://admhelp.microfocus.com/lr/en/12.56-12.57/help/WebHelp/Content/Controller/c_terms_lr.htm</p> <p>“After the recording, VuGen generates various functions that define the actions performed during the recording session. VuGen inserts these functions into the VuGen editor to create a basic Vuser script. Instead of having to manually program the application's API function calls to the server, VuGen automatically generates functions that model and emulate real world situations.”</p> <p>Micro Focus LoadRunner Help Center, https://admhelp.microfocus.com/lr/en/12.56-12.57/help/WebHelp/Content/VuGen/100050_c_vugen_overview.htm</p>
---	---

Claim 20, U.S. Pat. No. 9,298,864

Claim Element	Evidence of Infringement
<p>20. A method for emulating an application playing on an application player in each of a plurality of mobile devices, the method comprising:</p>	<p>Micro Focus TruClient Native Mobile provides a way to emulate mobile applications on both Android and iOS mobile devices.</p> <p>“The new TruClient – Native Mobile protocol provides a novel way to record and replay native mobile applications on both Android and iOS devices. The protocol enables the developer or DevOps engineer to record user interactions on the mobile application and create a TruClient script. This script can be enhanced using standard TruClient functionality including parameterization, transactions and JavaScript coding.”</p> <p>Micro Focus Introduction to LoadRunner’s new TruClient – Native Mobile protocol, https://community.softwaregrp.com/t5/LoadRunner-and-Performance/Introduction-to-LoadRunner-s-new-TruClient-Native-Mobile/ba-p/269441#.WxcGIO4vwuU</p> <p>“After the recording, VuGen generates various functions that define the actions performed during the recording session. VuGen inserts these functions into the VuGen editor to create a basic Vuser script. Instead of having to manually program the application's API function calls to the server, VuGen automatically generates functions that model and emulate real world situations.”</p> <p>— — Micro Focus LoadRunner Help Center, https://admhelp.microfocus.com/lr/en/12.56-12.57/help/WebHelp/Content/VuGen/100050_c_vugen_overview.htm</p>
<p>retrieving characteristics, indicative of performance, for each of the mobile devices;</p>	<p>Micro Focus TruClient Native Mobile retrieves mobile device characteristics indicative of performance and provides data of the application’s performance for a mobile device.</p> <p>“This protocol is meant for end-user performance testing. Together with the existing mobile protocols, it completes the LoadRunner mobile performance testing suite...</p> <p>Let’s discuss the ‘end-user performance’ test phase. This new protocol provides data of the application’s performance on a real device in different conditions.”</p> <p>Micro Focus Introduction to LoadRunner’s new TruClient – Native Mobile protocol, https://community.softwaregrp.com/t5/LoadRunner-and-Performance/Introduction-to-LoadRunner-s-new-TruClient-Native-Mobile/ba-p/269441#.WxcGIO4vwuU</p> <p>“Lab management</p> <p>Create and manage device groups and access permissions, schedule device reservations, get full control over a device, including system apps and remote restarts. Record and replay interactions, events and gestures on any app on any device or emulators.</p>

Claim 20, U.S. Pat. No. 9,298,864

Build a lab of mobile devices and emulators, allowing your team to reserve and control them remotely.

Extend your lab with public devices to enable a greater variety of models and operating systems, and allow you to select a device by its capabilities.”

MOBILE CENTER 1. DEVICE 2. APPS 3. TEST OPTIONS SAVE AND CLOSE

CREATE RULE

Choose the minimal capabilities required for your test. In runtime, you will be assigned an appropriate device.

OS (Required) ☐ Android ☐ iOS ☐ Windows Phone

OS Version OS Version

Manufacturer & Model
To match an exact string, use double quotes. For example, "Apple iPad mini 4"

No devices match your rule?
Replay your test on an Amazon device.

Preview of applicable devices 6/6 Devices

OS	Manufacturer & Model	OS Version	Form Factor	Lab
Apple	Apple iPad mini 2G (WiFi)	8.3	Tablet	Mobile Center Lab
Apple	Apple iPhone 6s	9.0.1	Phone	Mobile Center Lab
LGE	LGE Nexus SX	7.1.1	Phone	Mobile Center Lab
LGE	LGE Nexus SX	8.0.0	Phone	Mobile Center Lab
samsung	samsung GT-I919S	4.4.2	Phone	Mobile Center Lab
samsung	samsung SM-G920I	6.0.1	Phone	Mobile Center Lab

Micro Focus Mobile Center, <https://software.microfocus.com/en-us/products/mobile-testing/overview>

Claim 20, U.S. Pat. No. 9,298,864

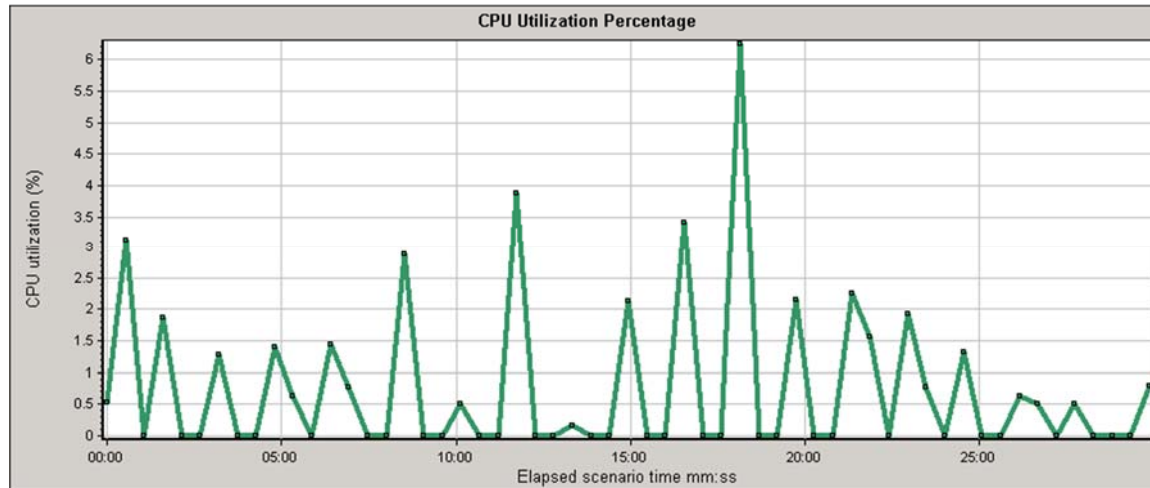
<p>emulating each of the mobile devices in real time using respective models running on a processor extrinsic to the mobile devices, wherein each of the models is based on the retrieved characteristics;</p>	<p>You can use TruClient to measure and monitor the device performance during the test run based on the device characteristics.</p> <p>“You can use TruClient transactions to measure the time that a set of steps (or a single step) complete. In addition, you can monitor device performance measurements during the test run. These measurements include:</p> <ul style="list-style-type: none"> • CPU consumed on the device • Free memory on the device • Memory consumed by the application.” <p>Micro Focus Corporate Website, Introduction to LoadRunner’s new TruClient – Native Mobile protocol, https://community.softwaregrp.com/t5/LoadRunner-and-Performance/Introduction-to-LoadRunner-s-new-TruClient-Native-Mobile/ba-p/269441#.WxcGIO4vwuU</p>
<p>playing the application in real time using the application player within each of the models;</p>	<p>“The new TruClient – Native Mobile protocol provides a novel way to record and replay native mobile applications on both Android and iOS devices. The protocol enables the developer or DevOps engineer to record user interactions on the mobile application and create a TruClient script.”</p> <p>Micro Focus Introduction to LoadRunner’s new TruClient – Native Mobile protocol, https://community.softwaregrp.com/t5/LoadRunner-and-Performance/Introduction-to-LoadRunner-s-new-TruClient-Native-Mobile/ba-p/269441#.WxcGIO4vwuU</p> <p>“Mobile Application Testing</p> <p>LoadRunner is the most complete solution for mobile application performance testing; including Mobile Web, Native and Hybrid applications. The TruClient—Mobile Web protocol supports the rapid testing of browser-based mobile applications, and the TruClient—Native Mobile protocol provides support for native, Web and Hybrid applications. Micro Focus solutions for mobile testing can be used to test mobile applications against any platform and OS. LoadRunner seamlessly integrates with Network Virtualization enabling realistic network conditions during each test.”</p> <p>Micro Focus LoadRunner Data Sheet, Page 3, Ex. G.</p>

Claim 20, U.S. Pat. No. 9,298,864

<p>monitoring the application playing in each of the models to determine resource utilization information by the application for each of the mobile devices;</p>	<p>“You can use TruClient transactions to measure the time that a set of steps (or a single step) complete. In addition, you can monitor device performance measurements during the test run. These measurements include:</p> <ul style="list-style-type: none"> • CPU consumed on the device • Free memory on the device • Memory consumed by the application.” <p>Micro Focus Introduction to LoadRunner’s new TruClient – Native Mobile protocol, https://community.softwaregrp.com/t5/LoadRunner-and-Performance/Introduction-to-LoadRunner-s-new-TruClient-Native-Mobile/ba-p/269441#.WxcGIO4vwuU</p>						
<p>and displaying the resource utilization information for at least one of the mobile devices.</p>	<p>TruClient then displays the resource utilization for the mobile device characteristic.</p> <p>“TruClient CPU Utilization Percentage Graph</p> <p>This graph displays the percentage of the CPU utilized during the test run for TruClient Native Mobile Vuser scripts.</p> <table border="1" data-bbox="508 901 1640 1198"> <tr> <td>Purpose</td><td>Helps you evaluate the amount of CPU utilized by an application.</td></tr> <tr> <td>X-axis</td><td>Elapsed time since the start of the scenario run.</td></tr> <tr> <td>Y-axis</td><td>The percentage of the CPU utilized during the test run.</td></tr> </table>	Purpose	Helps you evaluate the amount of CPU utilized by an application.	X-axis	Elapsed time since the start of the scenario run.	Y-axis	The percentage of the CPU utilized during the test run.
Purpose	Helps you evaluate the amount of CPU utilized by an application.						
X-axis	Elapsed time since the start of the scenario run.						
Y-axis	The percentage of the CPU utilized during the test run.						

Claim 20, U.S. Pat. No. 9,298,864

Example: In the following example, the CPU utilization peaked to approximately 6% at 18 minutes into the test run.”



Micro Focus LoadRunner Help Center, https://admhelp.microfocus.com/lr/en/12.56-12.57/help/WebHelp/Content/Analysis/ui_tc_CPU_graph.htm

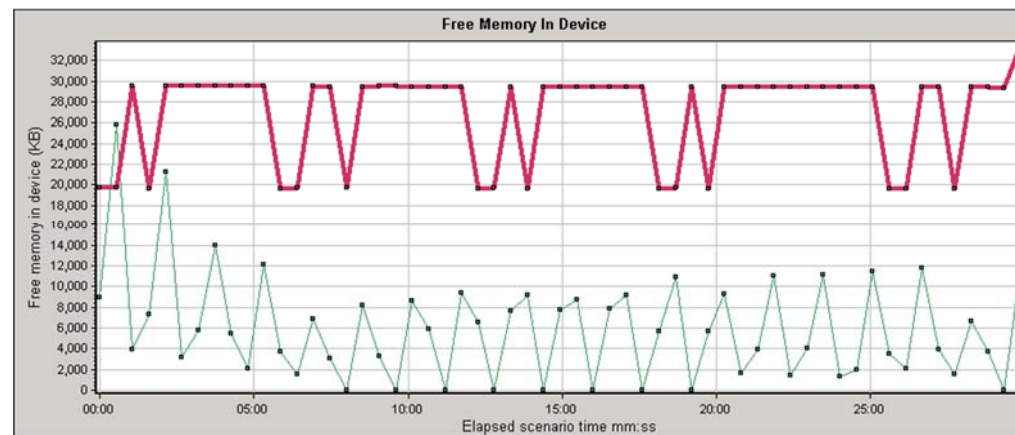
“TruClient Free Memory In Device Graph

This graph displays the free memory on a mobile device as a function of time, for TruClient Native Mobile scripts.

Claim 20, U.S. Pat. No. 9,298,864

Purpose	Helps you evaluate the amount of memory available on the device during the test run.
X-axis	Elapsed time since the start of the scenario run.
Y-axis	The amount of free memory in KBs.

Example: In the following example, the graph shows a free **memory** of over 33 MBs, at 30 minutes into the test run for one of the transactions.”



Micro Focus LoadRunner Help Center, https://admhelp.microfocus.com/lr/en/12.56-12.57/help/WebHelp/Content/Analysis/ui_tc_free_mem_graph.htm

“TruClient **Memory Consumed by Application Graph**

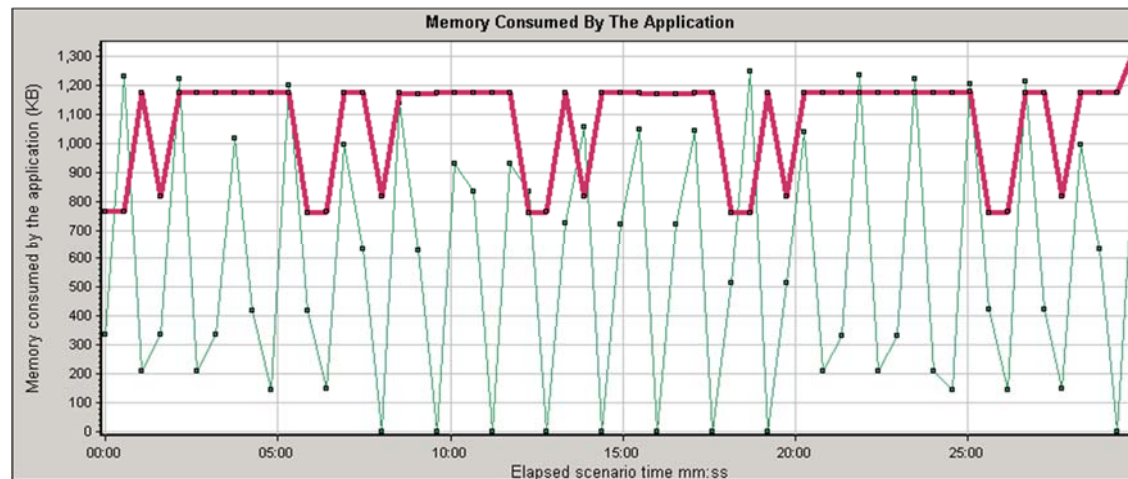
This graph displays the **memory** consumed by the application, as a function of time.

Purpose	Helps you evaluate the amount of memory used by the application.
----------------	---

Claim 20, U.S. Pat. No. 9,298,864

X-axis	Elapsed time since the start of the scenario run.
Y-axis	The memory consumed by the application in KBs.

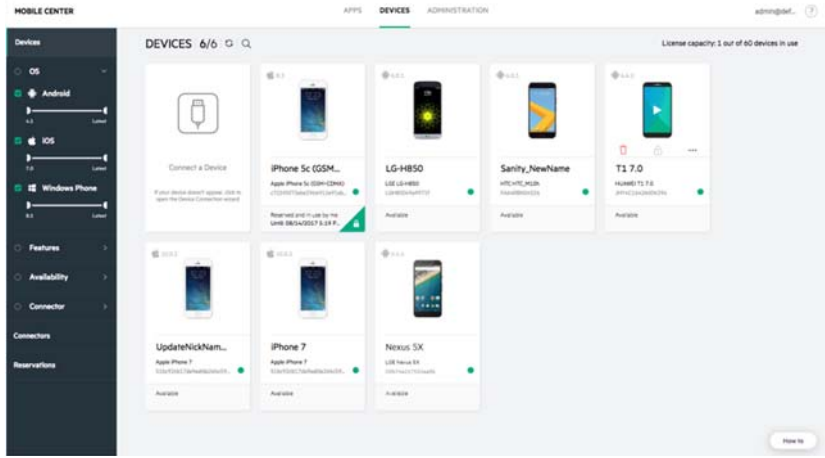
Example: In the following example, the **memory** consumption peaked to 1337 KBs at 30 minutes into the test, for one of the transactions.”



Micro Focus LoadRunner Help Center,

https://admhelp.microfocus.com/lr/en/12.56-12.57/help/WebHelp/Content/Analysis/ui_tc_consumed_mem_graph.htm

Claim 29, U.S. Pat. No. 9,298,864

Claim Element	Evidence of Infringement
<p>29. A method for emulating an application playing on at least one mobile device comprising:</p>	<p>Micro Focus Mobile Center provides a method for emulating an application to play on a mobile device.</p> <p>“Mobile Center Mobile Testing</p> <p>Micro Focus Mobile Center provides an end-to-end quality lab of real devices and emulators.”</p> <p>Micro Focus Mobile Center, https://software.microfocus.com/en-us/products/mobile-testing/overview</p>
<p>receiving instructions to select each said mobile device from a list including characteristics indicative of performance of each said mobile device;</p>	<p>“Lab management</p> <p>Create and manage device groups and access permissions, schedule device reservations, get full control over a device, including system apps and remote restarts. Record and replay interactions, events and gestures on any app on any device or emulators.</p> <p>Build a lab of mobile devices and emulators, allowing your team to reserve and control them remotely.</p> <p>Extend your lab with public devices to enable a greater variety of models and operating systems, and allow you to select a device by its capabilities.”</p> <p>Micro Focus Mobile Center, https://software.microfocus.com/en-us/products/mobile-testing/overview</p>  <p>The screenshot shows the 'MOBILE CENTER' interface with a sidebar menu on the left containing 'Devices', 'Features', 'Availability', 'Connector', and 'Reservations'. The main area is titled 'DEVICES 6/6' and displays a grid of device cards. Each card shows a device icon, name, OS version, and status (e.g., 'Available'). The devices listed include iPhone 5c GSM, LG-H850, Sanity_NewName, T1 7.0, UpdateNickNam..., iPhone 7, and Nexus 5X. A 'Connect a Device' button is visible at the top left of the device list.</p>

Claim 29, U.S. Pat. No. 9,298,864

<p>emulating each said mobile device using a respective model, wherein each said model is based upon the characteristics of a respective said mobile device;</p>	<p>“The new TruClient – Native Mobile protocol provides a novel way to record and replay native mobile applications on both Android and iOS devices. The protocol enables the developer or DevOps engineer to record user interactions on the mobile application and create a TruClient script. This script can be enhanced using standard TruClient functionality including parameterization, transactions and JavaScript coding.”</p> <p>Micro Focus Introduction to LoadRunner’s new TruClient – Native Mobile protocol, https://community.softwaregrp.com/t5/LoadRunner-and-Performance/Introduction-to-LoadRunner-s-new-TruClient-Native-Mobile/ba-p/269441#.WxcGI04vwuU</p> <p>“After the recording, VuGen generates various functions that define the actions performed during the recording session. VuGen inserts these functions into the VuGen editor to create a basic Vuser script. Instead of having to manually program the application's API function calls to the server, VuGen automatically generates functions that model and emulate real world situations.”</p> <p>— — Micro Focus LoadRunner Help Center, https://admhelp.microfocus.com/lr/en/12.56-12.57/help/WebHelp/Content/VuGen/100050_c_vugen_overview.htm</p> <p>“Lab management</p> <p>Create and manage device groups and access permissions, schedule device reservations, get full control over a device, including system apps and remote restarts. Record and replay interactions, events and gestures on any app on any device or emulators.</p> <p>Build a lab of mobile devices and emulators, allowing your team to reserve and control them remotely.</p> <p>Extend your lab with public devices to enable a greater variety of models and operating systems, and allow you to select a device by its capabilities.”</p>
--	---

Claim 29, U.S. Pat. No. 9,298,864

MOBILE CENTER

1: DEVICE 2: APPS 3: TEST OPTIONS SAVE AND CLOSE

Choose Capabilities

Choose Specific Device

CREATE RULE

Choose the minimal capabilities required for your test. In runtime, you will be assigned an appropriate device.

OS (Required)

☐ Android

☐ iOS

☐ Windows Phone

OS Version

Any ▼

OS Version

Manufacturer & Model

Enter manufacturer and/or model

To match an exact string, use double quotes. For example, "Apple iPad mini 4"

No devices match your rule?
Replay your test on an Amazon device.

Preview of applicable devices 6/6 Devices

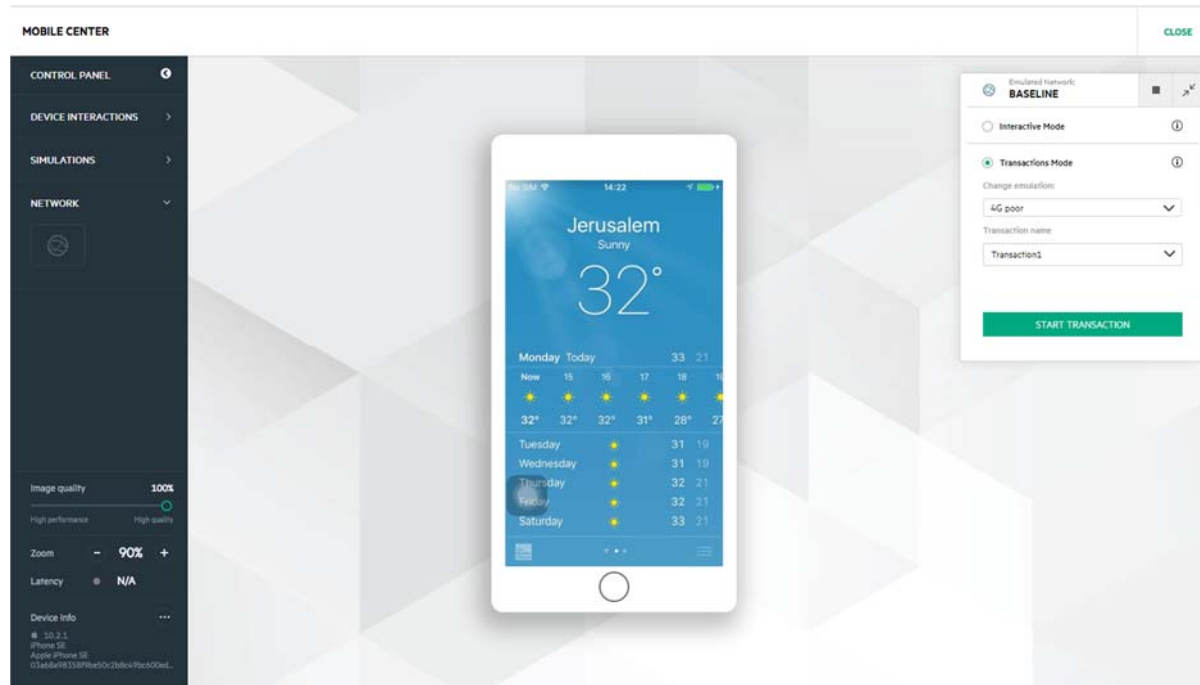
OS	Manufacturer & Model	OS Version	Form Factor	Lab
	Apple iPad mini 2G (WiFi)	8.3	Tablet	Mobile Center Lab
	Apple iPhone 6s	9.0.1	Phone	Mobile Center Lab
	LGE Nexus SX	7.1.1	Phone	Mobile Center Lab
	LGE Nexus SX	8.0.0	Phone	Mobile Center Lab
	samsung GT-I919S	4.4.2	Phone	Mobile Center Lab
	samsung SM-G920I	6.0.1	Phone	Mobile Center Lab

Micro Focus Mobile Center, <https://software.microfocus.com/en-us/products/mobile-testing/overview>

Claim 29, U.S. Pat. No. 9,298,864

playing the application in real time within each said model;

“Control your device remotely and simulate events such as GPS location and network speed changes, and other common events.”



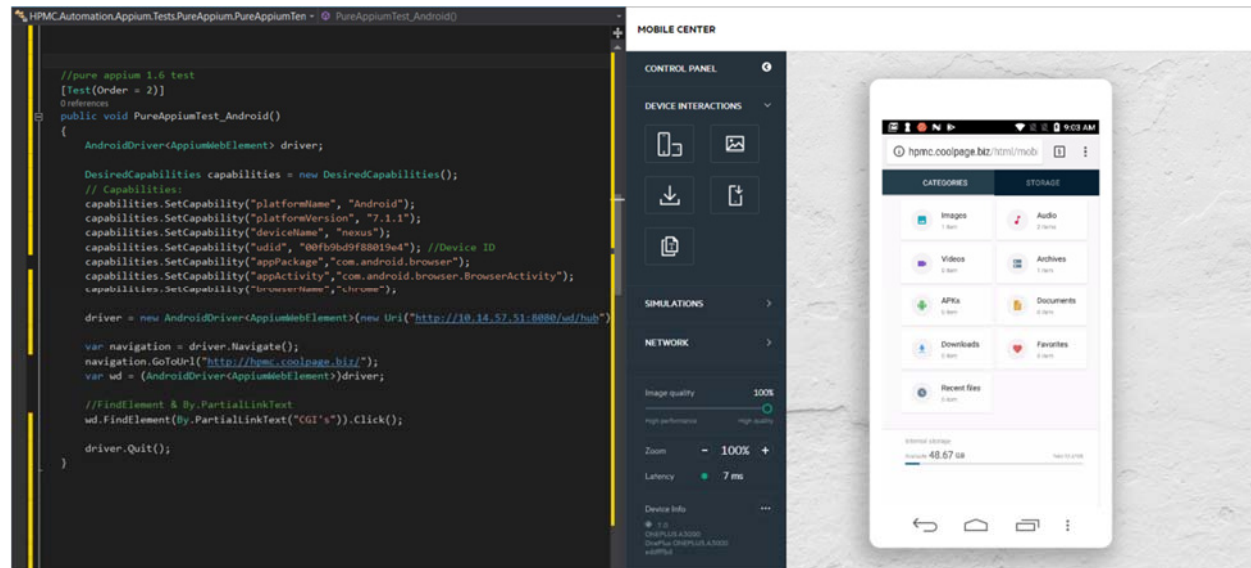
Micro Focus Mobile Center, <https://software.microfocus.com/en-us/products/mobile-testing/overview>

Claim 29, U.S. Pat. No. 9,298,864

monitoring each said model to determine resource utilization of the application for each said mobile device;

“Live monitoring

Proactively monitor your app from multiple geographies on real device to identify issues before customers see them. Leverage in-app analytics with actionable insights to improve your test effectiveness.”



Micro Focus Mobile Center, <https://software.microfocus.com/en-us/products/mobile-testing/overview>

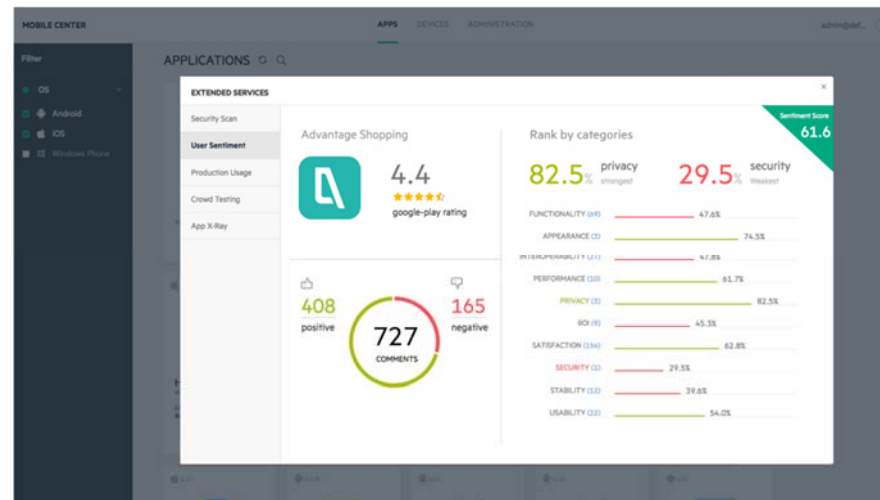
Claim 29, U.S. Pat. No. 9,298,864

and displaying
the resource
utilization
information.

“Mobile performance optimization

Get an accurate picture of the end-to-end mobile performance. Combine virtual users and real devices, run simple, elastic, and realistic tests from multiple geographies across various real-world network conditions.

Learn how your app scores in the app stores and prioritize your tests accordingly.”



Micro Focus Mobile Center, <https://software.microfocus.com/en-us/products/mobile-testing/overview>

“Our native, in-house support for mobile applications testing, with Mobile Center you take control of your mobile reality, and addresses the challenge of optimizing mobile app quality and user experience throughout the application lifecycle, with the tools you are already familiar with from us. This enables you to accelerate testing on

Claim 29, U.S. Pat. No. 9,298,864

real devices, increase coverage, and solve problems before they affect users. Built on native technology, **Mobile Center leverages** our expertise in functional and performance testing, and integrates mobile testing with **Sprinter, Unified Functional Testing, LoadRunner, and Performance Center.**”

Micro Focus Mobile Center, <https://community.softwaregrp.com/t5/Quality-and-Testing-Blog/New-Service-Pack-for-UFT-12-has-been-just-released/ba-p/250150#.WzagrtVKguV>

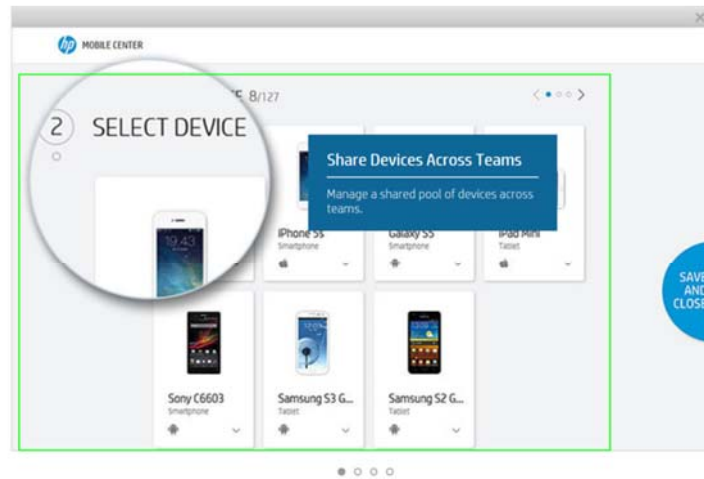
“This **new protocol** provides data of the **application’s performance** on a **real device** in different conditions. You can use TruClient transactions to measure the time that a set of steps (or a single step) complete. In addition, you can **monitor device performance measurements during the test run**. These measurements include:

- **CPU consumed on the device**
- **Free memory on the device**
- **Memory consumed by the application”**

Micro Focus Mobile Center, <https://community.softwaregrp.com/t5/LoadRunner-and-Performance/Introduction-to-LoadRunner-s-new-TruClient-Native-Mobile/ba-p/269441#.Wxcs2u4vwuU>

Claim 29, U.S. Pat. No. 9,298,864

Mobile Testing Screenshots



Connect your devices to Mobile Center and immediately test your mobile application on real devices. Flexible device management improves team collaboration and velocity.

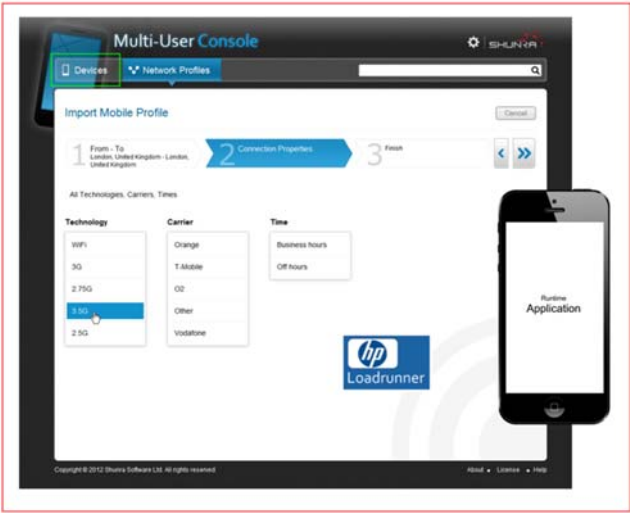


BANK OF AMERICA

Claim 1, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
<p>1. A system for testing an application for a mobile device comprising:</p>	<p>Each Micro Focus-related Accused System (which includes HP LoadRunner, HP Performance Center, HP StormRunner, HP Mobile Center, Shunra Network Virtualization, HP Network Virtualization engine, HP Network Virtualization for Mobile, HP Network Capture, and/or any Micro Focus products related to any of the foregoing) meets the elements of this claim (individually or collectively the “Micro Focus-related Infringing Products”). Please note that “HP”, “HPE” and “Micro Focus” are used interchangeably herein.</p> <p>“HP LoadRunner and HP Performance Center with Shunra Network Virtualization</p> <p>Improve the performance of mobile apps through effective testing...Shunra Network Virtualization, which integrates seamlessly into HP LoadRunner or Performance Center, enhances test accuracy by incorporating real-world network conditions into the load and performance test environment, ensuring that the test results are more reliable and accurate...The combination of HP LoadRunner or Performance Center and Shunra Network Virtualization is the path to robust, reliable, and accurate mobile performance testing.”</p> <p>HP LoadRunner and HP Performance Center with Shunra Network Virtualization, Page 1-3, Ex. A.</p> <p>“Built on the HP Network Virtualization engine, HP Network Virtualization for Mobile bridges the gap between development and deployment by enabling your mobile application development team to fully and accurately assess the behavior and impact of the network on mobile apps before they are introduced to end users. By virtualizing real-world mobile network conditions within testing environments, your test results are more reliably predictive of how an application will behave for end users.”</p> <p>HP Network Virtualization for Mobile, Page 2, Ex. B.</p> <p>The annotated image below illustrates the user interface for the LoadRunner platform, a system for testing an application for a mobile device.</p>

Claim 1, U.S. Pat. No. 9,971,678

	
<p>a software testing interface configured to simultaneously visually simulate, via one or more profile display windows, a plurality of operator network characteristics including at least bandwidth availability indicative of performance of the mobile device when executing the application;</p>	<p>Each Micro Focus-related Accused System is further configured to include a software testing interface [e.g., the LoadRunner interface] configured to simultaneously visually simulate, via one or more profile display windows [e.g., the window highlighted in green in the annotated image below], a plurality of operator network characteristics [e.g., communication technology such as 2.5G, 3.5G, WiFi, etc.] including at least bandwidth availability indicative of performance of the mobile device when executing the application [e.g., the communication technology corresponds to bandwidth availability indicative of performance]. Communication technology options are shown in the highlighted green box in the annotated image below.</p>

Claim 1, U.S. Pat. No. 9,971,678

“HP Network Virtualization for Mobile allows tests to be managed and results analyzed from any laptop or Wi-Fi-connected mobile device. The software can import **real-world mobile network profiles** captured by HP Network Capture or provided by the HP Network Virtualization Library of mobile and broadband network conditions.”

HP Network Virtualization for Mobile, Page 2, Ex. B.

“Because mobile network conditions are dynamic and vary by carrier, location, and time of day, it is essential for testing environments to accurately recreate multiple mobile network scenarios in order to analyze app performance and determine how network conditions affect different mobile users. The multi-flow capability in HP Network Virtualization for Mobile allows you to define a mobile test scenario that simultaneously emulates multiple user locations, each with its own unique set of virtualized mobile network conditions.”

HP Network Virtualization for Mobile, Page 4, Ex. B.

As illustrated below, each of the communication technology options has a corresponding network profile, which include a plurality of network characteristics.

“**Network Profiles . . . Profiles define the conditions for the test.** They can be based on Shunra’s™ Global Library recordings, or can be set manually. . . . The imported **profiles** are **recordings of mobile**

Claim 1, U.S. Pat. No. 9,971,678

conditions between two points. These recording files are stored in the Shunra Global Library which is a regularly updated, pre-populated set of more than 15 million recorded real-world data points of point-to-point network conditions recorded around the world. . . . You can manually define specific network conditions for an individual test and then save the Profile to be used in other tests.

To import a Profile:

1 In the Network Profiles tab the following general profiles are displayed (these profiles are already imported and do not require Internet access):

3G: latency 75 ms, download 780 Kbps, upload 330 Kbps, packet loss 0%

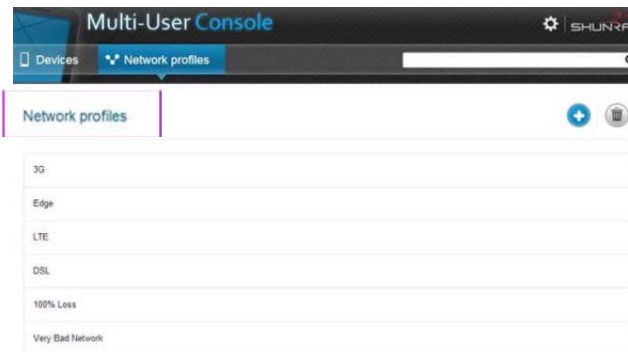
Edge: latency 200 ms, download 100 Kbps, upload 100 Kbps, packet loss 0%

LTE: latency 40ms, download 10,000 Kbps, upload 7500 Kbps, packet loss 0%

DSL: latency 25ms, download 2000 Kbps, upload 256 Kbps, packet loss 0%

100% Loss: latency 0 ms, download 10000 Kbps, upload 10000 Kbps, packet loss 100%

Very Bad Network: latency 500 ms, download 1000 Kbps, upload 1000 Kbps, packet loss 10%”



HP Network Virtualization for Mobile, Shunra vCat for Mobile Manual, Pages 19-20, Ex. C.

“HP Network Virtualization for Mobile is the only network virtualization solution designed specifically for the unique requirements of mobile app testing. Based on technology acquired from Shunra, this field-proven HP solution reduces the risk of poor mobile performance and helps your organization test, validate, and optimize the performance of your mobile apps before deployment.”

HP Network Virtualization for Mobile, Page 1, Ex. B.

Claim 1, U.S. Pat. No. 9,971,678

“Built on the HP Network Virtualization engine, HP Network Virtualization for Mobile bridges the gap between development and deployment by enabling your mobile application development team to fully and accurately assess the behavior and impact of the network on mobile apps before they are introduced to end users. By virtualizing real-world mobile network conditions within testing environments, your test results are more reliably predictive of how an application will behave for end users.”

HP Network Virtualization for Mobile, Page 2, Ex. B.

wherein the bandwidth availability is based at least in part on **bandwidth data predetermined from interactions between one or more mobile devices and at least one operator network.**

“Network Profiles . . . **Profiles define the conditions for the test.** They can be based on Shunra’s™ Global Library recordings, or can be set manually. . . . The imported profiles are **recordings of mobile conditions between two points.** These recording files are stored in the Shunra Global Library which is a **regularly updated, pre-populated set of more than 15 million recorded real-world data points of point-to-point network conditions recorded around the world.** . . . You can manually define specific network conditions for an individual test and then save the Profile to be used in other tests.”

The screenshot displays a three-step process for configuring a network profile:

- 1 From - To**: Tel Aviv, Israel - Tokyo, Japan
- 2 Connection Properties**: This step is highlighted with a blue arrow.
- 3**: (Partially visible)

Below the steps, the text "All Technologies, Carriers, Times" is shown. Three configuration panels are visible:

- Technology**: A list box containing WiFi, 3G, 2.75G, 3.5G, and 2.5G.
- Carrier**: A list box containing Other and Orange.
- Time**: A list box containing off work and work.

HP Network Virtualization for Mobile, Shunra vCat for Mobile Manual, Page 19, Ex. C.

“Micro Focus Network Virtualization Network Performance Testing

Claim 1, U.S. Pat. No. 9,971,678

Capture and emulate real-world network conditions, so you can execute network performance testing to detect and remediate issues before app deployment.

Discover and capture

Discover and capture live network performance conditions—such as latency, packet loss, bandwidth limitation and jitter—and recreate those conditions for network performance testing.”

Micro Focus Corporate Website, available at <https://software.microfocus.com/en-us/products/network-virtualization-for-load-testing/overview>

“Network Virtualization software allows you to discover and capture real-world network performance conditions from your production network, recreate network conditions in your lab during application testing, and optimize the applications to improve performance before you deploy into production.”

Micro Focus Network Virtualization Data Sheet, Page 1, Ex. D.

“Use Network Capture to record and identify application performance problems occurring at a remote location, by measuring network conditions such as latency, packet loss, bandwidth availability across any given network topology. Network Capture can measure production links around the globe for a duration of up to one month.”

HP Network Capture User Guide, Page 6, Ex. E.

“HP LoadRunner and HP Performance Center mobile testing protocols enable comprehensive performance testing of mobile applications for most mobile platforms—Android, iPhone®, Windows®, and others. Using the mobile protocols, the performance testing team is able to capture mobile traffic and generate realistic mobile load on the system under test.

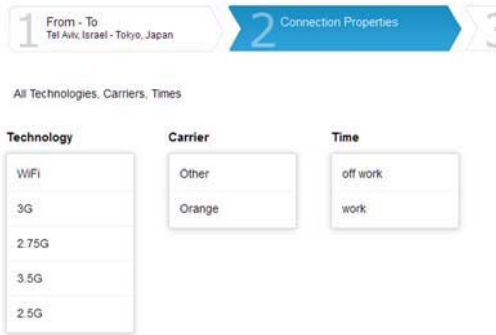
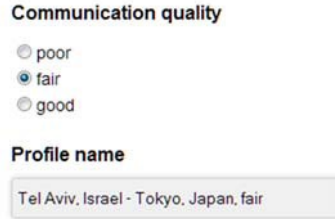
Features and benefits...

Shunra Network Virtualization enables an effective engineering methodology for application performance, providing the capabilities to discover real-world network conditions, virtualize those conditions in the test environment, analyze test results to isolate potential bottlenecks, and automatically deliver custom performance optimization recommendations. It provides:

Claim 1, U.S. Pat. No. 9,971,678

	<p>NetworkCatcher: The ability to automatically gather real-world network conditions, collecting interval statistics that include bidirectional bandwidth, latency, jitter, and packet loss conditions</p> <p>Global Library: Access to Shunra’s Global Library of mobile and broadband conditions provides up-to-date average, best-case, and worst-case network conditions from thousands of cities worldwide.”</p> <p>HP LoadRunner and HP Performance Center with Shunra Network Virtualization, Page 2-3, Ex. A.</p>
--	--

Claim 2, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
<p>2. The system of claim 1, wherein the software is configured to enable a user to select from one or more connection simulations for testing how well mobile content performs on the mobile device.</p>	<p>Each Micro Focus-related Accused System is further configured to enable a user to select from one or more network conditions for testing the mobile application.</p> <p>“In the Connection Properties, define the Technology, Carrier and Time of day.</p> <p>Note: The Technology and Carrier are related to the Client Location.</p>  <p>Select the forward arrows and choose one of the Communication quality options. If a WiFi connection was selected, select the required bandwidth.”</p>  <p>HP Network Virtualization for Mobile, Shunra vCat for Mobile Manual, Page 20-21, Ex. C.</p> <p>“Because mobile network conditions are dynamic and vary by carrier, location, and time of day, it is essential for testing environments to accurately recreate multiple mobile network scenarios in order to analyze app performance and determine how network conditions affect different mobile users. The multi-flow capability in HP Network Virtualization for Mobile allows you to define a mobile test</p>

Claim 2, U.S. Pat. No. 9,971,678

scenario that simultaneously emulates multiple user locations, each with its own unique set of virtualized mobile network conditions.”

HP Network Virtualization for Mobile, Page 4, Ex. B.

“Micro Focus Network Virtualization Network Performance Testing

Capture and emulate real-world network conditions, so you can execute network performance testing to detect and remediate issues before app deployment.

Discover and capture

Discover and capture live network performance conditions—such as latency, packet loss, bandwidth limitation and jitter—and recreate those conditions for network performance testing.”

Micro Focus Corporate Website, available at <https://software.microfocus.com/en-us/products/network-virtualization-for-load-testing/overview>.

“Network Virtualization software allows you to discover and capture real-world network performance conditions from your production network, recreate network conditions in your lab during application testing, and optimize the applications to improve performance before you deploy into production.”

Micro Focus Network Virtualization Data Sheet, Page 1, Ex. D.

“Network Profiles

Profiles define the conditions for the test. They can be based on Shunra’s™ Global Library recordings, or can be set manually.

The imported profiles are recordings of mobile conditions between two points. These recording files are stored in the Shunra Global Library which is a regularly updated, pre-populated set of more than 15 million recorded real-world data points of point-to-point network conditions recorded around the world.”

HP Network Virtualization for Mobile, Shunra vCat for Mobile Manual, Page 19, Ex. C.

Claim 2, U.S. Pat. No. 9,971,678

“Use Network Capture to record and identify application performance problems occurring at a remote location, by measuring network conditions such as latency, packet loss, bandwidth availability across any given network topology. Network Capture can measure production links around the globe for a duration of up to one month.”

HP Network Capture User Guide, Page 6, Ex. E.

“HP LoadRunner and HP Performance Center mobile testing protocols enable comprehensive performance testing of mobile applications for most mobile platforms—Android, iPhone®, Windows®, and others. Using the mobile protocols, the performance testing team is able to capture mobile traffic and generate realistic mobile load on the system under test.

Features and benefits...

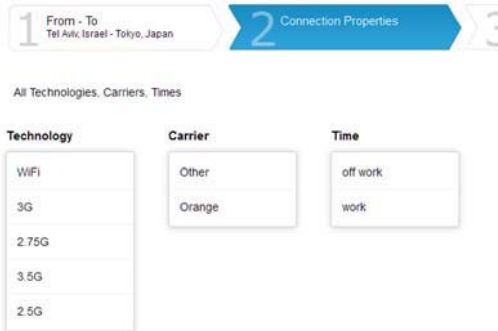

Shunra Network Virtualization enables an effective engineering methodology for application performance, providing the capabilities to discover real-world network conditions, virtualize those conditions in the test environment, analyze test results to isolate potential bottlenecks, and automatically deliver custom performance optimization recommendations. It provides:

NetworkCatcher: The ability to automatically gather real-world network conditions, collecting interval statistics that include bidirectional bandwidth, latency, jitter, and packet loss conditions

Global Library: Access to Shunra’s Global Library of mobile and broadband conditions provides up-to-date average, best-case, and worst-case network conditions from thousands of cities worldwide.”

HP LoadRunner and HP Performance Center with Shunra Network Virtualization, Page 2-3, Ex. A.

Claim 3, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
<p>3. The system of claim 2, wherein the one or more connection simulations are configured to simulate wireless transmission of content to the mobile device based on the selected connection simulation.</p>	<p>Each Micro Focus-related Accused System is further configured to enable a user to select from one or more network conditions for testing the mobile application.</p> <p>“In the Connection Properties, define the Technology, Carrier and Time of day.</p> <p>Note: The Technology and Carrier are related to the Client Location.</p>  <p>Select the forward arrows and choose one of the Communication quality options. If a WiFi connection was selected, select the required bandwidth.”</p>  <p>HP Network Virtualization for Mobile, Shunra vCat for Mobile Manual, Page 20-21, Ex. C.</p> <p>“Because mobile network conditions are dynamic and vary by carrier, location, and time of day, it is essential for testing environments to accurately recreate multiple mobile network scenarios in order to analyze app performance and determine how network conditions affect different mobile users. The multi-flow capability in HP Network Virtualization for Mobile allows you to define a mobile test</p>

Claim 3, U.S. Pat. No. 9,971,678

scenario that simultaneously emulates multiple user locations, each with its own unique set of virtualized mobile network conditions.”

HP Network Virtualization for Mobile, Page 4, Ex. B.

“Micro Focus Network Virtualization Network Performance Testing

Capture and emulate real-world network conditions, so you can execute network performance testing to detect and remediate issues before app deployment.

Discover and capture

Discover and capture live network performance conditions—such as latency, packet loss, bandwidth limitation and jitter—and recreate those conditions for network performance testing.”

Micro Focus Corporate Website, available at <https://software.microfocus.com/en-us/products/network-virtualization-for-load-testing/overview>.

“Network Virtualization software allows you to discover and capture real-world network performance conditions from your production network, recreate network conditions in your lab during application testing, and optimize the applications to improve performance before you deploy into production.”

Micro Focus Network Virtualization Data Sheet, Page 1, Ex. D.

“Network Profiles

Profiles define the conditions for the test. They can be based on Shunra’s™ Global Library recordings, or can be set manually.

The imported profiles are recordings of mobile conditions between two points. These recording files are stored in the Shunra Global Library which is a regularly updated, pre-populated set of more than 15 million recorded real-world data points of point-to-point network conditions recorded around the world.”

HP Network Virtualization for Mobile, Shunra vCat for Mobile Manual, Page 19, Ex. C.

Claim 3, U.S. Pat. No. 9,971,678

“Use Network Capture to record and identify application performance problems occurring at a remote location, by measuring network conditions such as latency, packet loss, bandwidth availability across any given network topology. Network Capture can measure production links around the globe for a duration of up to one month.”

HP Network Capture User Guide, Page 6, Ex. E.

“HP LoadRunner and HP Performance Center mobile testing protocols enable comprehensive performance testing of mobile applications for most mobile platforms—Android, iPhone®, Windows®, and others. Using the mobile protocols, the performance testing team is able to capture mobile traffic and generate realistic mobile load on the system under test.

Features and benefits...

Shunra Network Virtualization enables an effective engineering methodology for application performance, providing the capabilities to discover real-world network conditions, virtualize those conditions in the test environment, analyze test results to isolate potential bottlenecks, and automatically deliver custom performance optimization recommendations. It provides:

NetworkCatcher: The ability to automatically gather real-world network conditions, collecting interval statistics that include bidirectional bandwidth, latency, jitter, and packet loss conditions

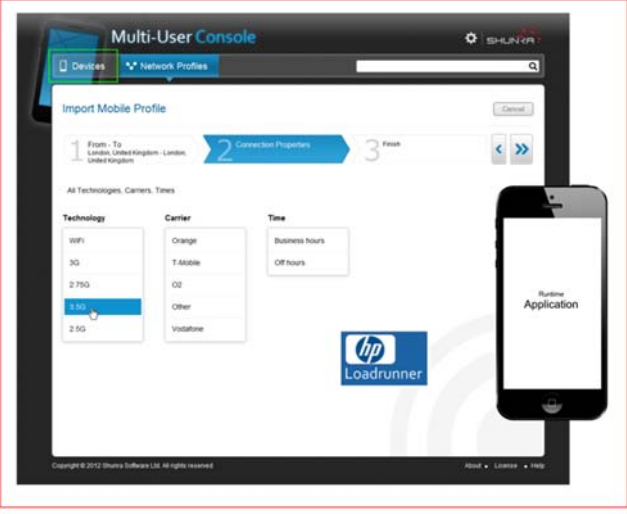
Global Library: Access to Shunra’s Global Library of mobile and broadband conditions provides up-to-date average, best-case, and worst-case network conditions from thousands of cities worldwide.”

HP LoadRunner and HP Performance Center with Shunra Network Virtualization, Page 2-3, Ex. A.

Claim 26, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
<p>26. A system for testing an application for a mobile device comprising:</p>	<p>Each Micro Focus-related Accused System (which includes HP LoadRunner, HP Performance Center, HP StormRunner, HP Mobile Center, Shunra Network Virtualization, HP Network Virtualization engine, HP Network Virtualization for Mobile, HP Network Capture, and/or any Micro Focus products related to any of the foregoing) meets the elements of this claim (individually or collectively the “Micro Focus-related Infringing Products”). Please note that “HP”, “HPE” and “Micro Focus” are used interchangeably herein.</p> <p>“HP LoadRunner and HP Performance Center with Shunra Network Virtualization</p> <p>Improve the performance of mobile apps through effective testing...Shunra Network Virtualization, which integrates seamlessly into HP LoadRunner or Performance Center, enhances test accuracy by incorporating real-world network conditions into the load and performance test environment, ensuring that the test results are more reliable and accurate...The combination of HP LoadRunner or Performance Center and Shunra Network Virtualization is the path to robust, reliable, and accurate mobile performance testing.”</p> <p>HP LoadRunner and HP Performance Center with Shunra Network Virtualization, Page 1-3, Ex. A.</p> <p>“Built on the HP Network Virtualization engine, HP Network Virtualization for Mobile bridges the gap between development and deployment by enabling your mobile application development team to fully and accurately assess the behavior and impact of the network on mobile apps before they are introduced to end users. By virtualizing real-world mobile network conditions within testing environments, your test results are more reliably predictive of how an application will behave for end users.”</p> <p>HP Network Virtualization for Mobile, Page 2, Ex. B.</p> <p>The annotated image below illustrates the user interface for the LoadRunner platform, a system for testing an application for a mobile device.</p>

Claim 26, U.S. Pat. No. 9,971,678

	
<p>a software testing interface configured to simultaneously visually simulate, via one or more profile display windows, a plurality of operator network characteristics including at least bandwidth availability indicative of performance of the mobile device when executing the application;</p>	<p>Each Micro Focus-related Accused System is further configured to include a software testing interface [e.g., the LoadRunner interface] configured to simultaneously visually simulate, via one or more profile display windows [e.g., the window highlighted in green in the annotated image below], a plurality of operator network characteristics [e.g., communication technology such as 2.5G, 3.5G, WiFi, etc.] including at least bandwidth availability indicative of performance of the mobile device when executing the application [e.g., the communication technology corresponds to bandwidth availability indicative of performance]. Communication technology options are shown in the highlighted green box in the annotated image below.</p>

Claim 26, U.S. Pat. No. 9,971,678

“HP Network Virtualization for Mobile allows tests to be managed and results analyzed from any laptop or Wi-Fi-connected mobile device. The software can import **real-world mobile network profiles** captured by HP Network Capture or provided by the HP Network Virtualization Library of mobile and broadband network conditions.”

HP Network Virtualization for Mobile, Page 2, Ex. B.

“Because mobile network conditions are dynamic and vary by carrier, location, and time of day, it is essential for testing environments to accurately recreate multiple mobile network scenarios in order to analyze app performance and determine how network conditions affect different mobile users. The multi-flow capability in HP Network Virtualization for Mobile allows you to define a mobile test scenario that simultaneously emulates multiple user locations, each with its own unique set of virtualized mobile network conditions.”

HP Network Virtualization for Mobile, Page 4, Ex. B.

As illustrated below, each of the communication technology options has a corresponding network profile, which include a plurality of network characteristics.

Claim 26, U.S. Pat. No. 9,971,678

“**Network Profiles . . . Profiles define the conditions for the test.** They can be based on Shunra’s™ Global Library recordings, or can be set manually. . . . The imported **profiles** are **recordings of mobile conditions between two points**. These recording files are stored in the Shunra Global Library which is a regularly updated, pre-populated set of more than 15 million recorded real-world data points of **point-to-point network conditions** recorded around the world. . . . You can manually define specific network conditions for an individual test and then save the **Profile** to be used in other tests.

To import a **Profile**:

1 In the **Network Profiles tab** the following general profiles are displayed (these profiles are already imported and do not require Internet access):

3G: latency 75 ms, download 780 Kbps, upload 330 Kbps, packet loss 0%

Edge: latency 200 ms, download 100 Kbps, upload 100 Kbps, packet loss 0%

LTE: latency 40ms, download 10,000 Kbps, upload 7500 Kbps, packet loss 0%

DSL: latency 25ms, download 2000 Kbps, upload 256 Kbps, packet loss 0%

100% Loss: latency 0 ms, download 10000 Kbps, upload 10000 Kbps, packet loss 100%

Very Bad Network: latency 500 ms, download 1000 Kbps, upload 1000 Kbps, packet loss 10%”



HP Network Virtualization for Mobile, Shunra vCat for Mobile Manual, Pages 19-20, Ex. C.

“HP Network Virtualization for Mobile is the only network virtualization solution designed specifically for the unique requirements of mobile app testing. Based on technology acquired from

Claim 26, U.S. Pat. No. 9,971,678

	<p>Shunra, this field-proven HP solution reduces the risk of poor mobile performance and helps your organization test, validate, and optimize the performance of your mobile apps before deployment.”</p> <p>HP Network Virtualization for Mobile, Page 1, Ex. B.</p> <p>“Built on the HP Network Virtualization engine, HP Network Virtualization for Mobile bridges the gap between development and deployment by enabling your mobile application development team to fully and accurately assess the behavior and impact of the network on mobile apps before they are introduced to end users. By virtualizing real-world mobile network conditions within testing environments, your test results are more reliably predictive of how an application will behave for end users.”</p> <p>HP Network Virtualization for Mobile, Page 2, Ex. B.</p>
wherein the bandwidth availability is based at least in part on bandwidth data predetermined from interactions between one or more mobile devices and at least one operator network	<p>“Network Profiles . . . Profiles define the conditions for the test. They can be based on Shunra’s™ Global Library recordings, or can be set manually. . . . The imported profiles are recordings of mobile conditions between two points. These recording files are stored in the Shunra Global Library which is a regularly updated, pre-populated set of more than 15 million recorded real-world data points of point-to-point network conditions recorded around the world. . . . You can manually define specific network conditions for an individual test and then save the Profile to be used in other tests.”</p> <div><div><p>HP Network Mobile, Shunra Manual, Page 19,</p></div><div><div><div><div>1</div><div>From - To Tel Aviv, Israel - Tokyo, Japan</div></div><div><div>2</div><div>Connection Properties</div></div><div><div>3</div><div></div></div></div><div>All Technologies, Carriers, Times</div></div><div><div><div><div>Technology</div><div>WiFi</div><div>3G</div><div>2.75G</div><div>3.5G</div><div>2.5G</div></div><div><div>Carrier</div><div>Other</div><div>Orange</div></div><div><div>Time</div><div>off work</div><div>work</div></div></div></div><div><p>Virtualization for vCat for Mobile Ex. C.</p></div></div>

Claim 26, U.S. Pat. No. 9,971,678

“Micro Focus Network Virtualization Network Performance Testing

Capture and emulate real-world network conditions, so you can execute network performance testing to detect and remediate issues before app deployment.

Discover and capture

Discover and capture live network performance conditions—such as latency, packet loss, bandwidth limitation and jitter—and recreate those conditions for network performance testing.”

Micro Focus Corporate Website, available at <https://software.microfocus.com/en-us/products/network-virtualization-for-load-testing/overview>

“Network Virtualization software allows you to discover and capture real-world network performance conditions from your production network, recreate network conditions in your lab during application testing, and optimize the applications to improve performance before you deploy into production.”

Micro Focus Network Virtualization Data Sheet, Page 1, Ex. D.

“Use Network Capture to record and identify application performance problems occurring at a remote location, by measuring network conditions such as latency, packet loss, bandwidth availability across any given network topology. Network Capture can measure production links around the globe for a duration of up to one month.”

HP Network Capture User Guide, Page 6, Ex. E.

“HP LoadRunner and HP Performance Center mobile testing protocols enable comprehensive

Claim 26, U.S. Pat. No. 9,971,678

	<p>performance testing of mobile applications for most mobile platforms—Android, iPhone®, Windows®, and others. Using the mobile protocols, the performance testing team is able to capture mobile traffic and generate realistic mobile load on the system under test.</p> <p>Features and benefits...</p> <p>Shunra Network Virtualization enables an effective engineering methodology for application performance, providing the capabilities to discover real-world network conditions, virtualize those conditions in the test environment, analyze test results to isolate potential bottlenecks, and automatically deliver custom performance optimization recommendations. It provides:</p> <p>NetworkCatcher: The ability to automatically gather real-world network conditions, collecting interval statistics that include bidirectional bandwidth, latency, jitter, and packet loss conditions</p> <p>Global Library: Access to Shunra’s Global Library of mobile and broadband conditions provides up-to-date average, best-case, and worst-case network conditions from thousands of cities worldwide.”</p> <p>HP LoadRunner and HP Performance Center with Shunra Network Virtualization, Page 2-3, Ex. A.</p>
<p>and the software is further configured to display data of either application performance, or network performance, or both.</p>	<p>Each Micro Focus-related Accused System is further configured to display application performance, or network performance, or both.</p> <p>“Location-Aware Analytics</p> <p>Network Virtualization software provides deep-dive analytic capabilities and location-specific network performance information. It helps you identify poorly performing business transactions and the root cause of performance issues. It provides service level and performance compliance reporting, and it is closely integrated with Micro Focus performance test products.</p> <p>Key Features</p> <p>While Network Virtualization software supports accurate prediction of the networked performance of</p>

Claim 26, U.S. Pat. No. 9,971,678

applications before you deploy them, Network Virtualization Analytics lets you drill down into the root cause of performance issues, and it provides recommendations for optimizing Web and mobile apps.”

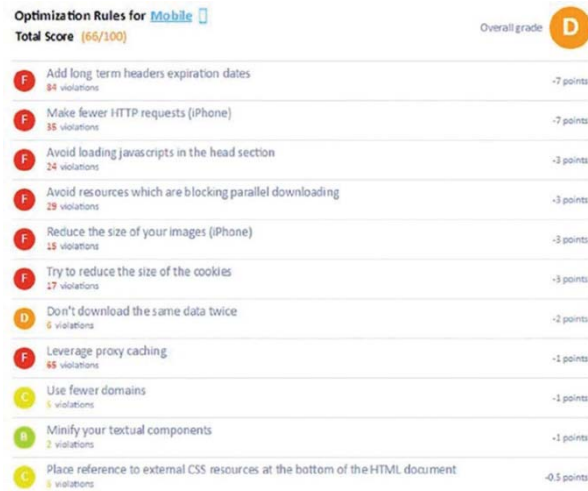


Figure 1. NV Analytics Report

“Web and Mobile Applications

In Network Virtualization Analytics, a waterfall diagram visualizes individual resource sizes and load times breaking down transaction response times, so you can quickly identify areas for optimization. These deep-dive capabilities show you how the end user experiences an application or page load and

Claim 26, U.S. Pat. No. 9,971,678

provide insight into client-network server timing by sub transaction.

Whether you are analyzing Web-based, mobile Web-based, or native mobile applications, this information is critical to understanding the end user's perception of performance and where you should focus your optimization efforts.

Automated Optimization Recommendations

Micro Focus Application Performance Analytics provides a transaction scorecard.”



Figure 2. NV Analytics Report Optimization Recommendations view

“In addition to providing extensive Web and mobile analysis, Network Virtualization Analytics delivers a transaction performance scorecard that automatically grades application performance and offers custom performance optimization suggestions based on industry accepted and additional proprietary rule sets.

Claim 26, U.S. Pat. No. 9,971,678

These performance optimization suggestions help improve the load time of mobile-optimized sites by at least 20 percent and of standard websites by a typical level of 44 percent when viewed on an iPhone. With comprehensive analysis capabilities, you can quickly and reliably identify bottlenecks and get specific recommendations for **performance optimization** to help you deliver applications that live up to the expectations of your users.”

“Network Virtualization software allows you to discover and capture real-world network performance conditions from your production network, recreate network conditions in your lab during application testing, and **optimize the applications to improve performance before you deploy into production.**”

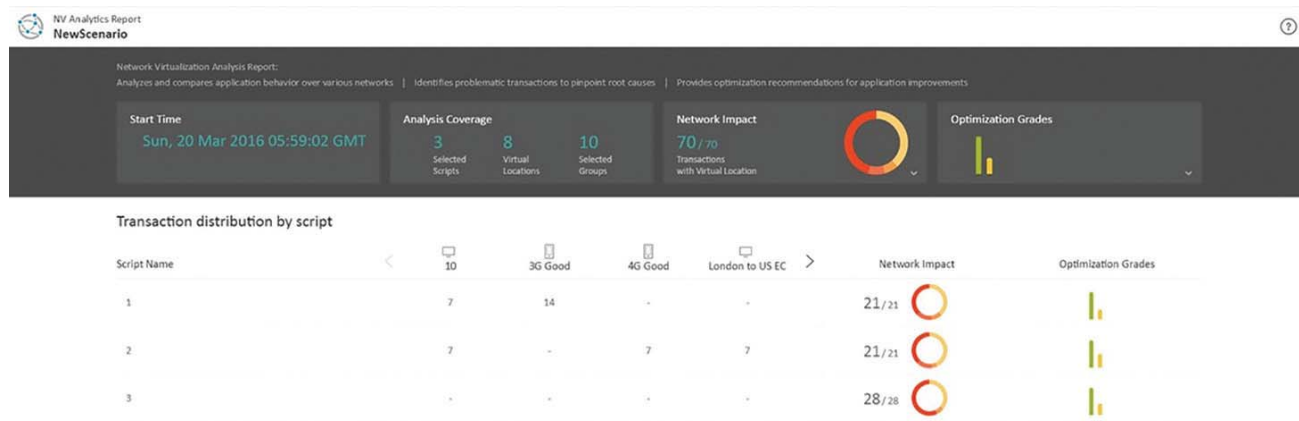


Figure 3. Analyst Report

“Transaction Analysis

Obtaining enhanced **performance information** on each transaction enables quick isolation of the root cause of **performance problems**. **Network Virtualization Analytics** includes the following reports to enable rapid analysis and problem diagnosis:

- The **transaction analysis report** shows how resource intensive a transaction is and enables

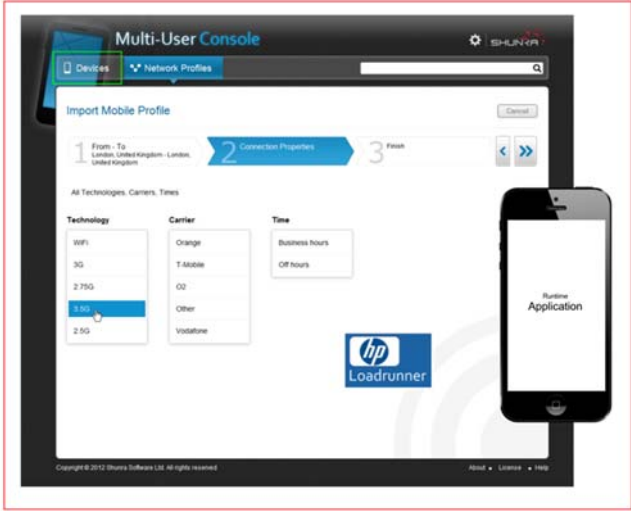
Claim 26, U.S. Pat. No. 9,971,678

	<p>comparison with other applications that are consuming the same network resources.</p> <ul style="list-style-type: none">■ The bandwidth bottleneck report identifies throughput and bandwidth utilization for each transaction.■ The network and application error report highlights all application-related errors and isolates problems such as caching issues, unutilized buffer size, and other functional problems for remediation.■ The breakdown analysis of infrastructure shows the elapsed time an application spends on the server, the client, and the network, helping to pinpoint bottlenecks in the application infrastructure.” <p>Micro Focus Network Virtualization Data Sheet, Pages 1-4, Ex. D</p>
--	--

Claim 37, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
<p>37. A system for testing an application for a mobile device comprising:</p>	<p>Each Micro Focus-related Accused System (which includes HP LoadRunner, HP Performance Center, HP StormRunner, HP Mobile Center, Shunra Network Virtualization, HP Network Virtualization engine, HP Network Virtualization for Mobile, HP Network Capture, and/or any Micro Focus products related to any of the foregoing) meets the elements of this claim (individually or collectively the “Micro Focus-related Infringing Products”). Please note that “HP”, “HPE” and “Micro Focus” are used interchangeably herein.</p> <p>“HP LoadRunner and HP Performance Center with Shunra Network Virtualization</p> <p>Improve the performance of mobile apps through effective testing...Shunra Network Virtualization, which integrates seamlessly into HP LoadRunner or Performance Center, enhances test accuracy by incorporating real-world network conditions into the load and performance test environment, ensuring that the test results are more reliable and accurate...The combination of HP LoadRunner or Performance Center and Shunra Network Virtualization is the path to robust, reliable, and accurate mobile performance testing.”</p> <p>HP LoadRunner and HP Performance Center with Shunra Network Virtualization, Page 1-3, Ex. A.</p> <p>“Built on the HP Network Virtualization engine, HP Network Virtualization for Mobile bridges the gap between development and deployment by enabling your mobile application development team to fully and accurately assess the behavior and impact of the network on mobile apps before they are introduced to end users. By virtualizing real-world mobile network conditions within testing environments, your test results are more reliably predictive of how an application will behave for end users.”</p> <p>HP Network Virtualization for Mobile, Page 2, Ex. B.</p> <p>The annotated image below illustrates the user interface for the LoadRunner platform, a system for testing an application for a mobile device.</p>

Claim 37, U.S. Pat. No. 9,971,678

	
<p>a software testing interface configured to simultaneously visually simulate, via one or more profile display windows, a plurality of operator network characteristics including at least bandwidth availability indicative of performance of the mobile device when executing the application;</p>	<p>Each Micro Focus-related Accused System is further configured to include a software testing interface [e.g., the LoadRunner interface] configured to simultaneously visually simulate, via one or more profile display windows [e.g., the window highlighted in green in the annotated image below], a plurality of operator network characteristics [e.g., communication technology such as 2.5G, 3.5G, WiFi, etc.] including at least bandwidth availability indicative of performance of the mobile device when executing the application [e.g., the communication technology corresponds to bandwidth availability indicative of performance]. Communication technology options are shown in the highlighted green box in the annotated image below.</p>

Claim 37, U.S. Pat. No. 9,971,678

“HP Network Virtualization for Mobile allows tests to be managed and results analyzed from any laptop or Wi-Fi-connected mobile device. The software can import **real-world mobile network profiles** captured by HP Network Capture or provided by the HP Network Virtualization Library of mobile and broadband network conditions.”

— — **HP Network Virtualization for Mobile, Page 2, Ex. B.**

“Because mobile network conditions are dynamic and vary by carrier, location, and time of day, it is essential for testing environments to accurately recreate multiple mobile network scenarios in order to analyze app performance and determine how network conditions affect different mobile users. The multi-flow capability in HP Network Virtualization for Mobile allows you to define a mobile test scenario that simultaneously emulates multiple user locations, each with its own unique set of virtualized mobile network conditions.”

— — **HP Network Virtualization for Mobile, Page 4, Ex B.**

As illustrated below, each of the technology options represents a network profile, which include a plurality of network characteristics.

“**Network Profiles . . . Profiles define the conditions for the test.** They can be based on Shunra’s™ Global Library recordings, or can be set manually. . . . The imported **profiles** are **recordings of mobile**

Claim 37, U.S. Pat. No. 9,971,678

conditions between two points. These recording files are stored in the Shunra Global Library which is a regularly updated, pre-populated set of more than 15 million recorded real-world data points of **point-to-point network conditions** recorded around the world. . . . You can manually define specific network conditions for an individual test and then save the **Profile** to be used in other tests.

To import a **Profile**:

1 In the **Network Profiles tab** the following general profiles are displayed (these profiles are already imported and do not require Internet access):

3G: latency 75 ms, download 780 Kbps, upload 330 Kbps, packet loss 0%

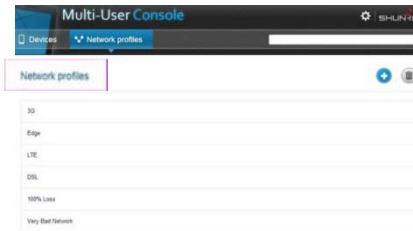
Edge: latency 200 ms, download 100 Kbps, upload 100 Kbps, packet loss 0%

LTE: latency 40ms, download 10,000 Kbps, upload 7500 Kbps, packet loss 0%

DSL: latency 25ms, download 2000 Kbps, upload 256 Kbps, packet loss 0%

100% Loss: latency 0 ms, download 10000 Kbps, upload 10000 Kbps, packet loss 100%

Very Bad Network: latency 500 ms, download 1000 Kbps, upload 1000 Kbps, packet loss 10%”



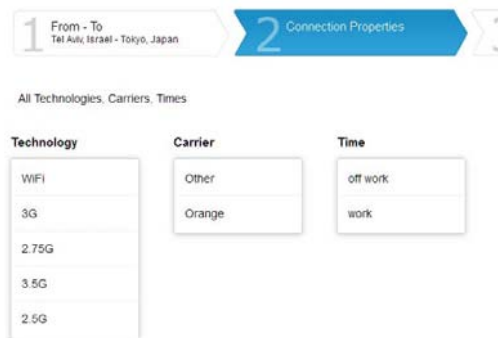
HP Network Virtualization for Mobile, Shunra vCat for Mobile Manual, Pages 19-20, Ex. C.

“HP Network Virtualization for Mobile is the only network virtualization solution designed specifically for the unique requirements of mobile app testing. Based on technology acquired from Shunra, this field-proven HP solution reduces the risk of poor mobile performance and helps your organization test, validate, and optimize the performance of your mobile apps before deployment.”

HP Network Virtualization for Mobile, Page 1, Ex. B.

“Built on the HP Network Virtualization engine, HP Network Virtualization for Mobile bridges the gap between development and deployment by enabling your mobile application development team to

Claim 37, U.S. Pat. No. 9,971,678

	<p>fully and accurately assess the behavior and impact of the network on mobile apps before they are introduced to end users. By virtualizing real-world mobile network conditions within testing environments, your test results are more reliably predictive of how an application will behave for end users.”</p> <p>HP Network Virtualization for Mobile, Page 2, Ex B.</p>
<p>wherein the bandwidth availability is based at least in part on bandwidth data predetermined from interactions between one or more mobile devices and at least one operator network</p>	<p>“Network Profiles . . . Profiles define the conditions for the test. They can be based on Shunra’s™ Global Library recordings, or can be set manually. . . . The imported profiles are recordings of mobile conditions between two points. These recording files are stored in the Shunra Global Library which is a regularly updated, pre-populated set of more than 15 million recorded real-world data points of point-to-point network conditions recorded around the world. . . . You can manually define specific network conditions for an individual test and then save the Profile to be used in other tests.”</p> <p>HP Network Virtualization for Mobile, Shunra vCat for Mobile Manual, Page 19, Ex. C.</p>  <p>“Micro Focus Network Virtualization Network Performance Testing</p> <p>Capture and emulate real-world network conditions, so you can execute network performance testing to detect and remediate issues before app deployment.</p>

Claim 37, U.S. Pat. No. 9,971,678**Discover and capture**

Discover and capture live network performance conditions—such as latency, packet loss, bandwidth limitation and jitter—and recreate those conditions for network performance testing.”

Micro Focus Corporate Website, available at <https://software.microfocus.com/en-us/products/network-virtualization-for-load-testing/overview>

“Network Virtualization software allows you to discover and capture real-world network performance conditions from your production network, recreate network conditions in your lab during application testing, and optimize the applications to improve performance before you deploy into production.”

Micro Focus Network Virtualization Data Sheet, Page 1, Ex. D.

“Use Network Capture to record and identify application performance problems occurring at a remote location, by measuring network conditions such as latency, packet loss, bandwidth availability across any given network topology. Network Capture can measure production links around the globe for a duration of up to one month.”

HP Network Capture User Guide, Page 6, Ex. E.

“HP LoadRunner and HP Performance Center mobile testing protocols enable comprehensive performance testing of mobile applications for most mobile platforms—Android, iPhone®, Windows®, and others. Using the mobile protocols, the performance testing team is able to capture mobile traffic and generate realistic mobile load on the system under test.

Features and benefits...

Shunra Network Virtualization enables an effective engineering methodology for application performance, providing the capabilities to discover real-world network conditions, virtualize those conditions in the test environment, analyze test results to isolate potential bottlenecks, and automatically deliver custom performance optimization recommendations. It provides:

Claim 37, U.S. Pat. No. 9,971,678

	<p>NetworkCatcher: The ability to automatically gather real-world network conditions, collecting interval statistics that include bidirectional bandwidth, latency, jitter, and packet loss conditions</p> <p>Global Library: Access to Shunra’s Global Library of mobile and broadband conditions provides up-to-date average, best-case, and worst-case network conditions from thousands of cities worldwide.”</p> <p>HP LoadRunner and HP Performance Center with Shunra Network Virtualization, Page 2-3, Ex. A.</p>
<p>and the software is further configured to interact with a network.</p>	<p>Each Micro Focus-related Accused System is further configured to interact with a network to enable cloud-based testing.</p> <p>“StormRunner Load</p> <p>Cloud Load Testing</p> <p>Simple, smart, and scalable cloud-based load and performance testing for web and mobile apps</p> <p>Simple</p> <p>Design and create mobile and web load test for easy cloud-based testing without the need to schedule, deploy, and manage load generators.</p> <p>Smart</p> <p>Detect problems fast and find your root cause with comprehensive analytics.</p> <p>Scalable</p> <p>Scale from 1 tester to 2,000,000 or more geographically distributed web and mobile users, add or remove them during runs.”</p> <p>Micro Focus Corporate Website, available at https://software.microfocus.com/en-us/products/network-virtualization-for-load-testing/overview</p>

Claim 37, U.S. Pat. No. 9,971,678

The software interacting with a network, for example, and creating Virtual Users are highlighted in the red box in the annotated image below.

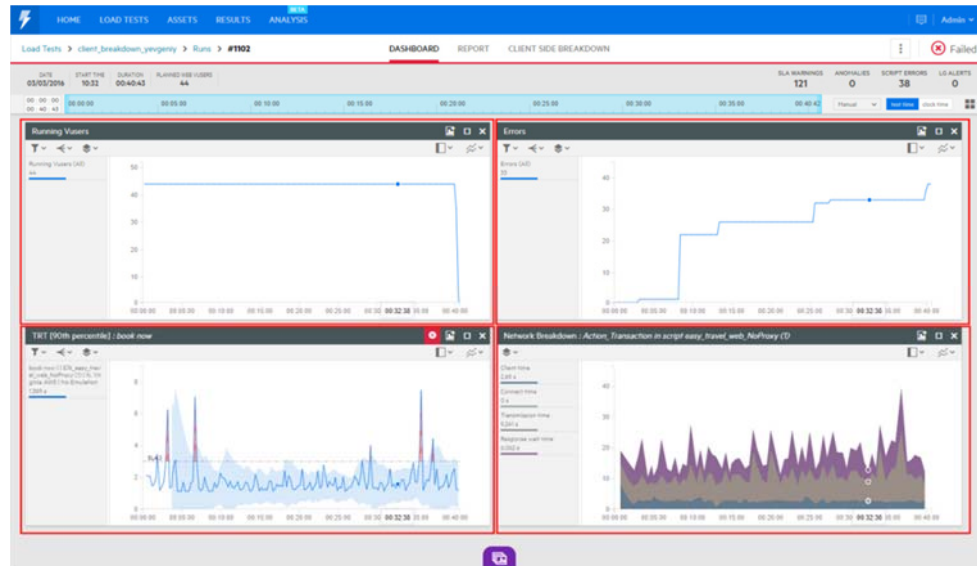


Figure 1. StormRunner Load

“Mobile performance optimization

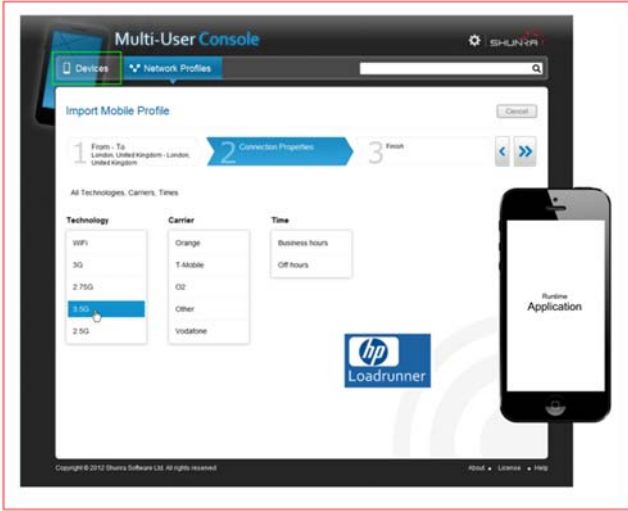
Get an accurate picture of the **end-to-end mobile performance**. Combine **virtual users and real devices**, run **simple, elastic, and realistic tests** from multiple geographies across various real-world network conditions.”

Micro Focus Corporate Website, available at <https://software.microfocus.com/en-us/products/mobile-testing/overview>

Claim 45, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
<p>45. A system for testing an application for a mobile device comprising:</p>	<p>Each Micro Focus-related Accused System (which includes HP LoadRunner, HP Performance Center, HP StormRunner, HP Mobile Center, Shunra Network Virtualization, HP Network Virtualization engine, HP Network Virtualization for Mobile, HP Network Capture, and/or any Micro Focus products related to any of the foregoing) meets the elements of this claim (individually or collectively the “Micro Focus-related Infringing Products”). Please note that “HP”, “HPE” and “Micro Focus” are used interchangeably herein.</p> <p>“HP LoadRunner and HP Performance Center with Shunra Network Virtualization</p> <p>Improve the performance of mobile apps through effective testing...Shunra Network Virtualization, which integrates seamlessly into HP LoadRunner or Performance Center, enhances test accuracy by incorporating real-world network conditions into the load and performance test environment, ensuring that the test results are more reliable and accurate...The combination of HP LoadRunner or Performance Center and Shunra Network Virtualization is the path to robust, reliable, and accurate mobile performance testing.”</p> <p>HP LoadRunner and HP Performance Center with Shunra Network Virtualization, Page 1-3, Ex. A.</p> <p>“Built on the HP Network Virtualization engine, HP Network Virtualization for Mobile bridges the gap between development and deployment by enabling your mobile application development team to fully and accurately assess the behavior and impact of the network on mobile apps before they are introduced to end users. By virtualizing real-world mobile network conditions within testing environments, your test results are more reliably predictive of how an application will behave for end users.”</p> <p>HP Network Virtualization for Mobile, Page 2, Ex. B.</p> <p>The annotated image below illustrates the user interface for the LoadRunner platform, a system for testing an application for a mobile device.</p>

Claim 45, U.S. Pat. No. 9,971,678

	
<p>a software testing interface configured to simultaneously visually simulate, via one or more profile display windows, a plurality of operator network characteristics including at least bandwidth availability indicative of performance of the mobile device when executing the application;</p>	<p>Each Micro Focus-related Accused System is further configured to include a software testing interface [e.g., the LoadRunner interface] configured to simultaneously visually simulate, via one or more profile display windows [e.g., the window highlighted in green in the annotated image below], a plurality of operator network characteristics [e.g., communication technology such as 2.5G, 3.5G, WiFi, etc.] including at least bandwidth availability indicative of performance of the mobile device when executing the application [e.g., the communication technology corresponds to bandwidth availability indicative of performance]. Communication technology options are shown in the highlighted green box in the annotated image below.</p>

Claim 45, U.S. Pat. No. 9,971,678

“HP Network Virtualization for Mobile allows tests to be managed and results analyzed from any laptop or Wi-Fi-connected mobile device. The software can import **real-world mobile network profiles** captured by HP Network Capture or provided by the HP Network Virtualization Library of mobile and broadband network conditions.”

— — **HP Network Virtualization for Mobile, Page 2, Ex. B.**

“Because mobile network conditions are dynamic and vary by carrier, location, and time of day, it is essential for testing environments to accurately recreate multiple mobile network scenarios in order to analyze app performance and determine how network conditions affect different mobile users. The multi-flow capability in HP Network Virtualization for Mobile allows you to define a mobile test scenario that simultaneously emulates multiple user locations, each with its own unique set of virtualized mobile network conditions.”

— — **HP Network Virtualization for Mobile, Page 4, Ex B.**

As illustrated below, each of the technology options represents a network profile, which include a plurality of network characteristics.

“**Network Profiles . . . Profiles define the conditions for the test.** They can be based on Shunra’s™

Claim 45, U.S. Pat. No. 9,971,678

Global Library recordings, or can be set manually. . . . The imported **profiles** are **recordings of mobile conditions between two points**. These recording files are stored in the Shunra Global Library which is a regularly updated, pre-populated set of more than 15 million recorded real-world data points of **point-to-point network conditions** recorded around the world. . . . You can manually define specific network conditions for an individual test and then save the **Profile** to be used in other tests.

To import a **Profile**:

1 In the **Network Profiles** tab the following general profiles are displayed (these profiles are already imported and do not require Internet access):

3G: latency 75 ms, download 780 Kbps, upload 330 Kbps, packet loss 0%

Edge: latency 200 ms, download 100 Kbps, upload 100 Kbps, packet loss 0%

LTE: latency 40ms, download 10,000 Kbps, upload 7500 Kbps, packet loss 0%

DSL: latency 25ms, download 2000 Kbps, upload 256 Kbps, packet loss 0%

100% Loss: latency 0 ms, download 10000 Kbps, upload 10000 Kbps, packet loss 100%

Very Bad Network: latency 500 ms, download 1000 Kbps, upload 1000 Kbps, packet loss 10%”

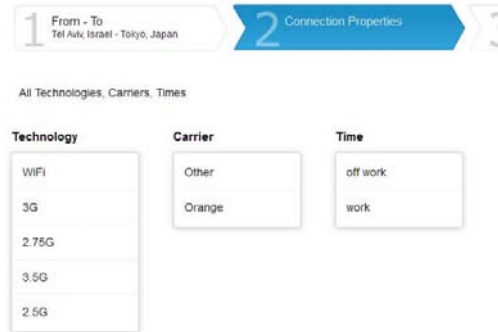


HP Network Virtualization for Mobile, Shunra vCat for Mobile Manual, Pages 19-20, Ex. C.

“HP Network Virtualization for Mobile is the only network virtualization solution designed specifically for the unique requirements of mobile app testing. Based on technology acquired from Shunra, this field-proven HP solution reduces the risk of poor mobile performance and helps your organization test, validate, and optimize the performance of your mobile apps before deployment.”

HP Network Virtualization for Mobile, Page 1, Ex. B.

Claim 45, U.S. Pat. No. 9,971,678

	<p>“Built on the HP Network Virtualization engine, HP Network Virtualization for Mobile bridges the gap between development and deployment by enabling your mobile application development team to fully and accurately assess the behavior and impact of the network on mobile apps before they are introduced to end users. By virtualizing real-world mobile network conditions within testing environments, your test results are more reliably predictive of how an application will behave for end users.”</p> <p>HP Network Virtualization for Mobile, Page 2, Ex B.</p>
<p>wherein the bandwidth availability is based at least in part on bandwidth data predetermined from interactions between one or more mobile devices and at least one operator network</p>	<p>“Network Profiles . . . Profiles define the conditions for the test. They can be based on Shunra’s™ Global Library recordings, or can be set manually. . . . The imported profiles are recordings of mobile conditions between two points. These recording files are stored in the Shunra Global Library which is a regularly updated, pre-populated set of more than 15 million recorded real-world data points of point-to-point network conditions recorded around the world. . . . You can manually define specific network conditions for an individual test and then save the Profile to be used in other tests.”</p> <p>HP Network Virtualization for Mobile, Shunra vCat for Mobile Manual, Page 19, Ex. C.</p>  <p>“Micro Focus Network Virtualization Network Performance Testing</p> <p>Capture and emulate real-world network conditions, so you can execute network performance testing to detect and remediate issues before app deployment.</p>

Claim 45, U.S. Pat. No. 9,971,678**Discover and capture**

Discover and capture live network performance conditions—such as latency, packet loss, bandwidth limitation and jitter—and recreate those conditions for network performance testing.”

Micro Focus Corporate Website, available at <https://software.microfocus.com/en-us/products/network-virtualization-for-load-testing/overview>

“Network Virtualization software allows you to discover and capture real-world network performance conditions from your production network, recreate network conditions in your lab during application testing, and optimize the applications to improve performance before you deploy into production.”

Micro Focus Network Virtualization Data Sheet, Page 1, Ex. D.

“Use Network Capture to record and identify application performance problems occurring at a remote location, by measuring network conditions such as latency, packet loss, bandwidth availability across any given network topology. Network Capture can measure production links around the globe for a duration of up to one month.”

HP Network Capture User Guide, Page 6, Ex. E.

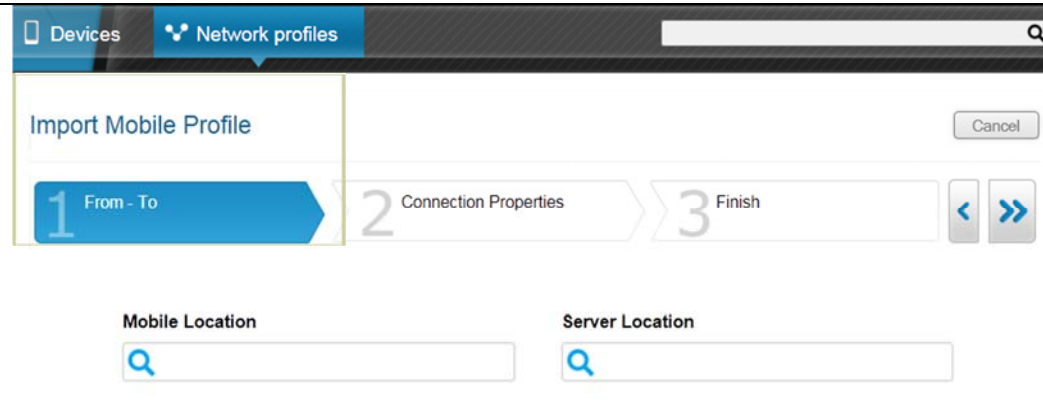
“HP LoadRunner and HP Performance Center mobile testing protocols enable comprehensive performance testing of mobile applications for most mobile platforms—Android, iPhone®, Windows®, and others. Using the mobile protocols, the performance testing team is able to capture mobile traffic and generate realistic mobile load on the system under test.

Features and benefits...

Shunra Network Virtualization enables an effective engineering methodology for application performance, providing the capabilities to discover real-world network conditions, virtualize those conditions in the test environment, analyze test results to isolate potential bottlenecks, and automatically deliver custom performance optimization recommendations. It provides:

Claim 45, U.S. Pat. No. 9,971,678

	<p>NetworkCatcher: The ability to automatically gather real-world network conditions, collecting interval statistics that include bidirectional bandwidth, latency, jitter, and packet loss conditions</p> <p>Global Library: Access to Shunra's Global Library of mobile and broadband conditions provides up-to-date average, best-case, and worst-case network conditions from thousands of cities worldwide."</p> <p>HP LoadRunner and HP Performance Center with Shunra Network Virtualization, Page 2-3, Ex. A.</p>
and interaction with a network enables the software to import real-world mobile network profiles.	<p>Each Micro Focus-related Accused System is further configured to import real-world mobile network profiles.</p> <p>"Network Profiles</p> <p>Profiles define the conditions for the test. They can be based on Shunra's™ Global Library recordings, or can be set manually.</p> <p>The imported profiles are recordings of mobile conditions between two points. These recording files are stored in the Shunra Global Library which is a regularly updated, pre-populated set of more than 15 million recorded real-world data points of point-to-point network conditions recorded around the world."</p> <p>...In the From-To, select the Mobile and Server locations, such as the name of a city or state."</p>

Claim 45, U.S. Pat. No. 9,971,678

HP Network Virtualization for Mobile, Shunra vCat for Mobile Manual, Page 19-20, Ex. C.

“APE — Best Practices

Discovery: identify and record real-world infrastructure and network conditions, business processes, application topology and deployment scenarios.

Pre-recorded library of global mobile and broadband network profiles enables rapid testing of mobile applications.

Pre-recorded network profiles for emulating typical mobile and broadband network conditions between major global cities.”

Built-in MySQL database stores thousands of network profiles.”

Shunra NetworkCatcher, Page 2, Ex. F.

“Micro Focus Network Virtualization
Network Performance Testing

Capture and emulate real-world network conditions, so you can execute network performance testing

Claim 45, U.S. Pat. No. 9,971,678

to detect and remediate issues before app deployment.

Discover and capture

Discover and capture live network performance conditions—such as latency, packet loss, bandwidth limitation and jitter—and recreate those conditions for network performance testing.”

Micro Focus Corporate Website, available at <https://software.microfocus.com/en-us/products/network-virtualization-for-load-testing/overview>

“Network Virtualization software allows you to discover and capture real-world network performance conditions from your production network, recreate network conditions in your lab during application testing, and optimize the applications to improve performance before you deploy into production.”

Micro Focus Network Virtualization Data Sheet, Page 1, Ex D.

“Use Network Capture to record and identify application performance problems occurring at a remote location, by measuring network conditions such as latency, packet loss, bandwidth availability across any given network topology. Network Capture can measure production links around the globe for a duration of up to one month.”

HP Network Capture User Guide, Page 6, Ex E.

“HP LoadRunner and HP Performance Center mobile testing protocols enable comprehensive performance testing of mobile applications for most mobile platforms—Android, iPhone®, Windows®, and others. Using the mobile protocols, the performance testing team is able to capture mobile traffic and generate realistic mobile load on the system under test.

Claim 45, U.S. Pat. No. 9,971,678

Features and benefits

Shunra Network Virtualization enables an effective engineering methodology for application performance, providing the capabilities to discover **real-world network conditions**, virtualize those conditions in the test environment, analyze test results to isolate potential bottlenecks, and automatically deliver custom performance optimization recommendations. It provides:

NetworkCatcher: The ability to automatically gather **real-world network conditions**, collecting interval statistics that include bidirectional bandwidth, latency, jitter, and packet loss conditions

Global Library: Access to Shunra's **Global Library** of **mobile and broadband conditions** provides up-to-date average, best-case, and worst-case network conditions **from thousands of cities worldwide.**"

HP LoadRunner and HP Performance Center with Shunra Network Virtualization, Page 2-3, Ex. A.

Claim 45, U.S. Pat. No. 9,971,678

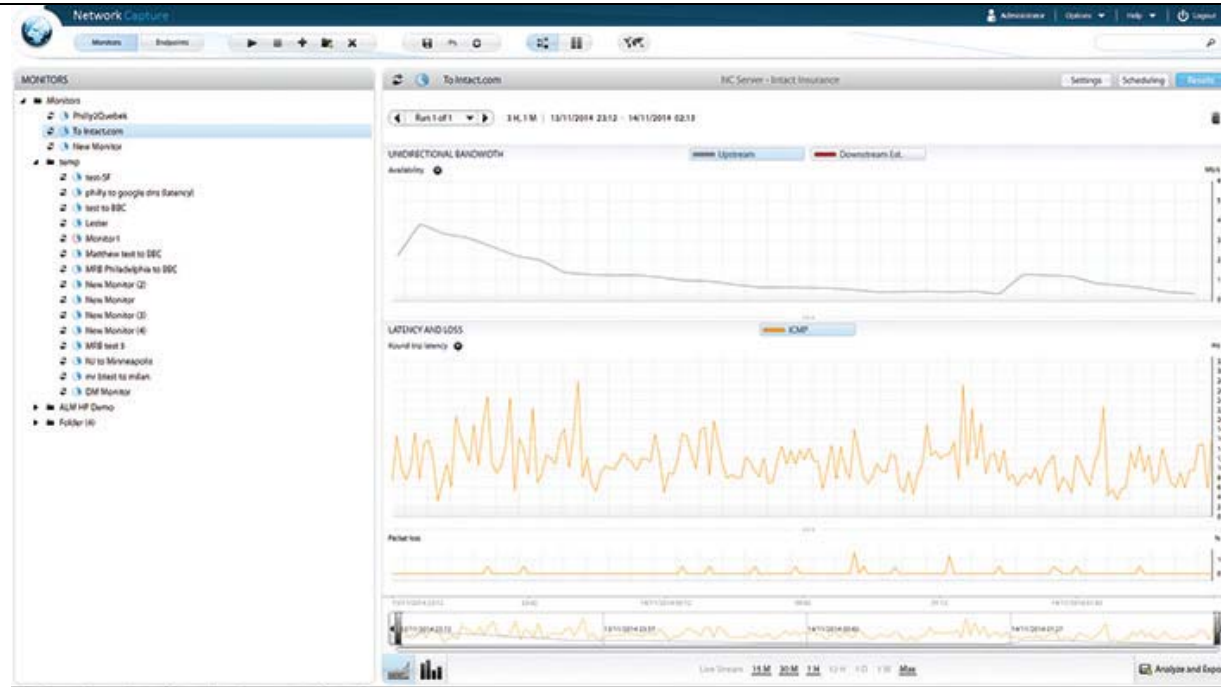
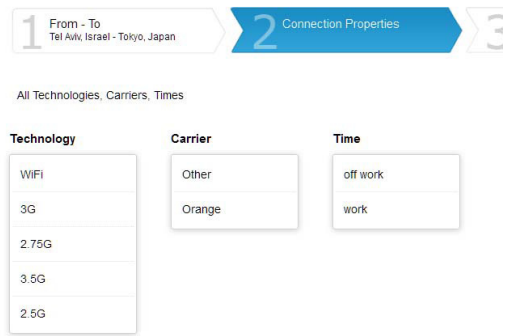


Figure 1. Network Capture

Micro Focus Network Virtualization Data Sheet, Page 2, Ex. D.

Claim 46 U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
<p>46. The system of claim 45, wherein the software is further configured to allow tests to be managed and results analyzed from a personal computer or mobile device.</p>	<p>Each Micro Focus-related Accused System is further configured to allow tests to be managed and results analyzed from a personal computer or mobile device.</p> <p>“Network Profiles . . . Profiles define the conditions for the test. They can be based on Shunra’s™ Global Library recordings, or can be set manually. . . . The imported profiles are recordings of mobile conditions between two points. These recording files are stored in the Shunra Global Library which is a regularly updated, pre-populated set of more than 15 million recorded real-world data points of point-to-point network conditions recorded around the world. . . . You can manually define specific network conditions for an individual test and then save the Profile to be used in other tests.”</p> <p>HP Network Virtualization for Mobile, Shunra vCat for Mobile Manual, Page 19, Ex. C.</p>  <p>“Micro Focus Network Virtualization Network Performance Testing</p> <p>Capture and emulate real-world network conditions, so you can execute network performance testing to detect and remediate issues before app deployment.</p>

Claim 46, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
	<p data-bbox="562 256 835 289">Discover and capture</p> <p data-bbox="562 329 1837 435">Discover and capture live network performance conditions—such as latency, packet loss, bandwidth limitation and jitter—and recreate those conditions for network performance testing.”</p> <p data-bbox="562 475 1837 548">Micro Focus Corporate Website, available at https://software.microfocus.com/en-us/products/network-virtualization-for-load-testing/overview</p> <p data-bbox="562 589 1837 727">“Network Virtualization software allows you to discover and capture real-world network performance conditions from your production network, recreate network conditions in your lab during application testing, and optimize the applications to improve performance before you deploy into production.”</p> <p data-bbox="562 768 1417 800">Micro Focus Network Virtualization Data Sheet, Page 1, Ex. D.</p> <p data-bbox="562 841 1837 979">“Use Network Capture to record and identify application performance problems occurring at a remote location, by measuring network conditions such as latency, packet loss, bandwidth availability across any given network topology. Network Capture can measure production links around the globe for a duration of up to one month.”</p> <p data-bbox="562 1019 1222 1052">HP Network Capture User Guide, Page 6, Ex. E.</p>

Claim 46, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
	<p data-bbox="562 329 1864 472">“HP LoadRunner and HP Performance Center mobile testing protocols enable comprehensive performance testing of mobile applications for most mobile platforms—Android, iPhone®, Windows®, and others. Using the mobile protocols, the performance testing team is able to capture mobile traffic and generate realistic mobile load on the system under test.</p> <p data-bbox="562 513 863 542">Features and benefits...</p> <p data-bbox="562 584 1864 727">Shunra Network Virtualization enables an effective engineering methodology for application performance, providing the capabilities to discover real-world network conditions, virtualize those conditions in the test environment, analyze test results to isolate potential bottlenecks, and automatically deliver custom performance optimization recommendations. It provides:</p> <p data-bbox="562 805 1864 873">NetworkCatcher: The ability to automatically gather real-world network conditions, collecting interval statistics that include bidirectional bandwidth, latency, jitter, and packet loss conditions</p> <p data-bbox="562 914 1864 982">Global Library: Access to Shunra’s Global Library of mobile and broadband conditions provides up-to-date average, best-case, and worst-case network conditions from thousands of cities worldwide.”</p> <p data-bbox="514 1023 1816 1091">HP LoadRunner and HP Performance Center with Shunra Network Virtualization, Page 2-3, Ex. A.</p>

Claim 46, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
	<p>The software is further configured to import real-world mobile network profiles.</p> <p>“Network Profiles</p> <p>Profiles define the conditions for the test. They can be based on Shunra’s™ Global Library recordings, or can be set manually.</p> <p>The imported profiles are recordings of mobile conditions between two points. These recording files are stored in the Shunra Global Library which is a regularly updated, pre-populated set of more than 15 million recorded real-world data points of point-to-point network conditions recorded around the world.”</p> <p>...In the From-To, select the Mobile and Server locations, such as the name of a city or state.”</p> <p>HP Network Virtualization for Mobile, Shunra vCat for Mobile Manual, Page 19-20, Ex. C.</p> <p>“APE — Best Practices</p> <p>Discovery: identify and record real-world infrastructure and network conditions, business processes, application topology and deployment scenarios.</p> <p>Pre-recorded library of global mobile and broadband network profiles enables rapid testing of mobile applications.</p> <p>Pre-recorded network profiles for emulating typical mobile and broadband network conditions between major global cities.”</p> <p>Built-in MySQL database stores thousands of network profiles.”</p> <p>Shunra NetworkCatcher, Page 2, Ex. F.</p>

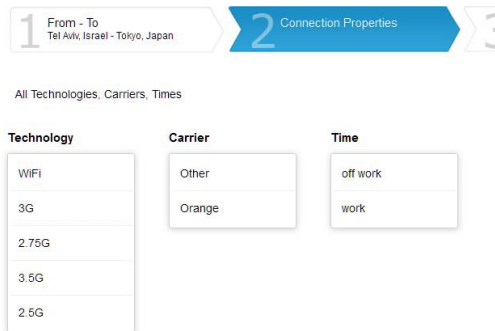
Claim 46, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
	<p data-bbox="562 256 1041 326">“Micro Focus Network Virtualization Network Performance Testing</p> <p data-bbox="562 367 1860 436">Capture and emulate real-world network conditions, so you can execute network performance testing to detect and remediate issues before app deployment.</p> <p data-bbox="562 477 831 513">Discover and capture</p> <p data-bbox="562 553 1860 623">Discover and capture live network performance conditions—such as latency, packet loss, bandwidth limitation and jitter—and recreate those conditions for network performance testing.”</p> <p data-bbox="562 696 1860 766">Micro Focus Corporate Website, available at https://software.microfocus.com/en-us/products/network-virtualization-for-load-testing/overview</p> <p data-bbox="562 839 1860 985">“Network Virtualization software allows you to discover and capture real-world network performance conditions from your production network, recreate network conditions in your lab during application testing, and optimize the applications to improve performance before you deploy into production.”</p> <p data-bbox="562 1026 1409 1062">Micro Focus Network Virtualization Data Sheet, Page 1, Ex D.</p>

Claim 46, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
	<p data-bbox="562 256 1864 402">“Use Network Capture to record and identify application performance problems occurring at a remote location, by measuring network conditions such as latency, packet loss, bandwidth availability across any given network topology. Network Capture can measure production links around the globe for a duration of up to one month.”</p> <p data-bbox="562 440 1213 475">HP Network Capture User Guide, Page 6, Ex E.</p> <p data-bbox="562 623 1864 769">“HP LoadRunner and HP Performance Center mobile testing protocols enable comprehensive performance testing of mobile applications for most mobile platforms—Android, iPhone®, Windows®, and others. Using the mobile protocols, the performance testing team is able to capture mobile traffic and generate realistic mobile load on the system under test.</p> <p data-bbox="562 807 835 839">Features and benefits</p> <p data-bbox="562 881 1864 1027">Shunra Network Virtualization enables an effective engineering methodology for application performance, providing the capabilities to discover real-world network conditions, virtualize those conditions in the test environment, analyze test results to isolate potential bottlenecks, and automatically deliver custom performance optimization recommendations. It provides:</p> <p data-bbox="562 1065 1864 1133">NetworkCatcher: The ability to automatically gather real-world network conditions, collecting interval statistics that include bidirectional bandwidth, latency, jitter, and packet loss conditions</p> <p data-bbox="562 1175 1864 1243">Global Library: Access to Shunra’s Global Library of mobile and broadband conditions provides up-to-date average, best-case, and worst-case network conditions from thousands of cities worldwide.”</p> <p data-bbox="562 1286 1864 1354">HP LoadRunner and HP Performance Center with Shunra Network Virtualization, Page 2-3, Ex. A.</p>

Claim 47 U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
<p>47. The system of claim 45, wherein the software can import real-world mobile network profiles captured by one or more networks.</p>	<p>Each Micro Focus-related Accused System is further configured to import real-world mobile network profiles captured by one or more networks.</p> <p>“Network Profiles . . . Profiles define the conditions for the test. They can be based on Shunra’s™ Global Library recordings, or can be set manually. . . . The imported profiles are recordings of mobile conditions between two points. These recording files are stored in the Shunra Global Library which is a regularly updated, pre-populated set of more than 15 million recorded real-world data points of point-to-point network conditions recorded around the world. . . . You can manually define specific network conditions for an individual test and then save the Profile to be used in other tests.”</p> <p>HP Network Virtualization for Mobile, Shunra vCat for Mobile Manual, Page 19, Ex. C.</p>  <p>The screenshot shows a three-step process for configuring a network profile. Step 1, 'From - To', shows a route from Tel Aviv, Israel to Tokyo, Japan. Step 2, 'Connection Properties', is highlighted in blue and shows three dropdown menus: 'Technology' (with options: WIFI, 3G, 2.75G, 3.5G, 2.5G), 'Carrier' (with options: Other, Orange), and 'Time' (with options: off work, work). Below the dropdowns, it says 'All Technologies, Carriers, Times'.</p> <p>“Micro Focus Network Virtualization Network Performance Testing</p> <p>Capture and emulate real-world network conditions, so you can execute network performance testing to detect and remediate issues before app deployment.</p>

Claim 47, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
	<p data-bbox="562 256 835 289">Discover and capture</p> <p data-bbox="562 329 1837 435">Discover and capture live network performance conditions—such as latency, packet loss, bandwidth limitation and jitter—and recreate those conditions for network performance testing.”</p> <p data-bbox="562 475 1837 548">Micro Focus Corporate Website, available at https://software.microfocus.com/en-us/products/network-virtualization-for-load-testing/overview</p> <p data-bbox="562 589 1837 727">“Network Virtualization software allows you to discover and capture real-world network performance conditions from your production network, recreate network conditions in your lab during application testing, and optimize the applications to improve performance before you deploy into production.”</p> <p data-bbox="562 768 1417 800">Micro Focus Network Virtualization Data Sheet, Page 1, Ex. D.</p> <p data-bbox="562 841 1837 979">“Use Network Capture to record and identify application performance problems occurring at a remote location, by measuring network conditions such as latency, packet loss, bandwidth availability across any given network topology. Network Capture can measure production links around the globe for a duration of up to one month.”</p> <p data-bbox="562 1019 1222 1052">HP Network Capture User Guide, Page 6, Ex. E.</p>

Claim 47, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
	<p data-bbox="562 329 1864 472">“HP LoadRunner and HP Performance Center mobile testing protocols enable comprehensive performance testing of mobile applications for most mobile platforms—Android, iPhone®, Windows®, and others. Using the mobile protocols, the performance testing team is able to capture mobile traffic and generate realistic mobile load on the system under test.</p> <p data-bbox="562 513 863 542">Features and benefits...</p> <p data-bbox="562 584 1864 727">Shunra Network Virtualization enables an effective engineering methodology for application performance, providing the capabilities to discover real-world network conditions, virtualize those conditions in the test environment, analyze test results to isolate potential bottlenecks, and automatically deliver custom performance optimization recommendations. It provides:</p> <p data-bbox="562 805 1864 873">NetworkCatcher: The ability to automatically gather real-world network conditions, collecting interval statistics that include bidirectional bandwidth, latency, jitter, and packet loss conditions</p> <p data-bbox="562 914 1864 982">Global Library: Access to Shunra’s Global Library of mobile and broadband conditions provides up-to-date average, best-case, and worst-case network conditions from thousands of cities worldwide.”</p> <p data-bbox="514 1024 1816 1092">HP LoadRunner and HP Performance Center with Shunra Network Virtualization, Page 2-3, Ex. A.</p>

Claim 47, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
	<p>The software is further configured to import real-world mobile network profiles.</p> <p>“Network Profiles</p> <p>Profiles define the conditions for the test. They can be based on Shunra’s™ Global Library recordings, or can be set manually.</p> <p>The imported profiles are recordings of mobile conditions between two points. These recording files are stored in the Shunra Global Library which is a regularly updated, pre-populated set of more than 15 million recorded real-world data points of point-to-point network conditions recorded around the world.”</p> <p>...In the From-To, select the Mobile and Server locations, such as the name of a city or state.”</p> <p>HP Network Virtualization for Mobile, Shunra vCat for Mobile Manual, Page 19-20, Ex. C.</p> <p>“APE — Best Practices</p> <p>Discovery: identify and record real-world infrastructure and network conditions, business processes, application topology and deployment scenarios.</p> <p>Pre-recorded library of global mobile and broadband network profiles enables rapid testing of mobile applications.</p> <p>Pre-recorded network profiles for emulating typical mobile and broadband network conditions between major global cities.”</p> <p>Built-in MySQL database stores thousands of network profiles.”</p> <p>Shunra NetworkCatcher, Page 2, Ex. F.</p>

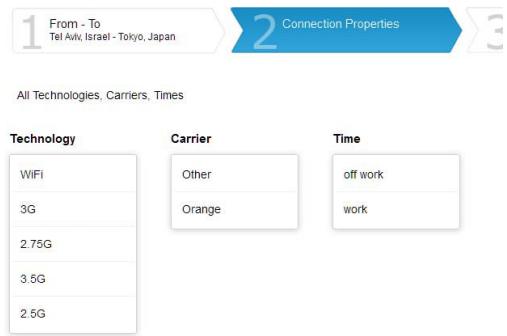
Claim 47, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
	<p data-bbox="562 256 1041 326">“Micro Focus Network Virtualization Network Performance Testing</p> <p data-bbox="562 367 1860 436">Capture and emulate real-world network conditions, so you can execute network performance testing to detect and remediate issues before app deployment.</p> <p data-bbox="562 477 831 513">Discover and capture</p> <p data-bbox="562 553 1860 623">Discover and capture live network performance conditions—such as latency, packet loss, bandwidth limitation and jitter—and recreate those conditions for network performance testing.”</p> <p data-bbox="562 696 1860 766">Micro Focus Corporate Website, available at https://software.microfocus.com/en-us/products/network-virtualization-for-load-testing/overview</p> <p data-bbox="562 839 1860 985">“Network Virtualization software allows you to discover and capture real-world network performance conditions from your production network, recreate network conditions in your lab during application testing, and optimize the applications to improve performance before you deploy into production.”</p> <p data-bbox="562 1026 1409 1062">Micro Focus Network Virtualization Data Sheet, Page 1, Ex D.</p>

Claim 47, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
	<p>“Use Network Capture to record and identify application performance problems occurring at a remote location, by measuring network conditions such as latency, packet loss, bandwidth availability across any given network topology. Network Capture can measure production links around the globe for a duration of up to one month.”</p> <p>HP Network Capture User Guide, Page 6, Ex E.</p> <p>“HP LoadRunner and HP Performance Center mobile testing protocols enable comprehensive performance testing of mobile applications for most mobile platforms—Android, iPhone®, Windows®, and others. Using the mobile protocols, the performance testing team is able to capture mobile traffic and generate realistic mobile load on the system under test.</p> <p>Features and benefits</p> <p>Shunra Network Virtualization enables an effective engineering methodology for application performance, providing the capabilities to discover real-world network conditions, virtualize those conditions in the test environment, analyze test results to isolate potential bottlenecks, and automatically deliver custom performance optimization recommendations. It provides:</p> <p>NetworkCatcher: The ability to automatically gather real-world network conditions, collecting interval statistics that include bidirectional bandwidth, latency, jitter, and packet loss conditions</p> <p>Global Library: Access to Shunra’s Global Library of mobile and broadband conditions provides up-to-date average, best-case, and worst-case network conditions from thousands of cities worldwide.”</p> <p>HP LoadRunner and HP Performance Center with Shunra Network Virtualization, Page 2-3, Ex. A.</p>

Claim 48 U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
<p>48. The system of claim 45, wherein the software can import real-world mobile network profiles provided by a storage library of mobile network conditions.</p>	<p>Each Micro Focus-related Accused System is further configured to import real-world mobile network profiles provided by a storage library of mobile network conditions.</p> <p>“Network Profiles . . . Profiles define the conditions for the test. They can be based on Shunra’s™ Global Library recordings, or can be set manually. . . . The imported profiles are recordings of mobile conditions between two points. These recording files are stored in the Shunra Global Library which is a regularly updated, pre-populated set of more than 15 million recorded real-world data points of point-to-point network conditions recorded around the world. . . . You can manually define specific network conditions for an individual test and then save the Profile to be used in other tests.”</p> <p>HP Network Virtualization for Mobile, Shunra vCat for Mobile Manual, Page 19, Ex. C.</p>  <p>The screenshot shows a two-step process for configuring a network profile. Step 1, 'From - To', shows a route from Tel Aviv, Israel to Tokyo, Japan. Step 2, 'Connection Properties', shows three dropdown menus: 'Technology' (with options WiFi, 3G, 2.75G, 3.5G, 2.5G), 'Carrier' (with options Other, Orange), and 'Time' (with options off work, work). Below the dropdowns, it says 'All Technologies, Carriers, Times'.</p> <p>“Micro Focus Network Virtualization Network Performance Testing</p> <p>Capture and emulate real-world network conditions, so you can execute network performance testing to detect and remediate issues before app deployment.</p>

Claim 48, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
	<p data-bbox="562 256 835 289">Discover and capture</p> <p data-bbox="562 329 1837 435">Discover and capture live network performance conditions—such as latency, packet loss, bandwidth limitation and jitter—and recreate those conditions for network performance testing.”</p> <p data-bbox="562 475 1837 548">Micro Focus Corporate Website, available at https://software.microfocus.com/en-us/products/network-virtualization-for-load-testing/overview</p> <p data-bbox="562 589 1837 727">“Network Virtualization software allows you to discover and capture real-world network performance conditions from your production network, recreate network conditions in your lab during application testing, and optimize the applications to improve performance before you deploy into production.”</p> <p data-bbox="562 768 1417 800">Micro Focus Network Virtualization Data Sheet, Page 1, Ex. D.</p> <p data-bbox="562 841 1837 979">“Use Network Capture to record and identify application performance problems occurring at a remote location, by measuring network conditions such as latency, packet loss, bandwidth availability across any given network topology. Network Capture can measure production links around the globe for a duration of up to one month.”</p> <p data-bbox="562 1019 1222 1052">HP Network Capture User Guide, Page 6, Ex. E.</p>

Claim 48, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
	<p data-bbox="562 329 1864 472">“HP LoadRunner and HP Performance Center mobile testing protocols enable comprehensive performance testing of mobile applications for most mobile platforms—Android, iPhone®, Windows®, and others. Using the mobile protocols, the performance testing team is able to capture mobile traffic and generate realistic mobile load on the system under test.</p> <p data-bbox="562 513 863 542">Features and benefits...</p> <p data-bbox="562 584 1864 727">Shunra Network Virtualization enables an effective engineering methodology for application performance, providing the capabilities to discover real-world network conditions, virtualize those conditions in the test environment, analyze test results to isolate potential bottlenecks, and automatically deliver custom performance optimization recommendations. It provides:</p> <p data-bbox="562 805 1864 873">NetworkCatcher: The ability to automatically gather real-world network conditions, collecting interval statistics that include bidirectional bandwidth, latency, jitter, and packet loss conditions</p> <p data-bbox="562 914 1864 982">Global Library: Access to Shunra’s Global Library of mobile and broadband conditions provides up-to-date average, best-case, and worst-case network conditions from thousands of cities worldwide.”</p> <p data-bbox="514 1023 1816 1091">HP LoadRunner and HP Performance Center with Shunra Network Virtualization, Page 2-3, Ex. A.</p>

Claim 48, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
	<p>The software is further configured to import real-world mobile network profiles.</p> <p>“Network Profiles</p> <p>Profiles define the conditions for the test. They can be based on Shunra’s™ Global Library recordings, or can be set manually.</p> <p>The imported profiles are recordings of mobile conditions between two points. These recording files are stored in the Shunra Global Library which is a regularly updated, pre-populated set of more than 15 million recorded real-world data points of point-to-point network conditions recorded around the world.”</p> <p>...In the From-To, select the Mobile and Server locations, such as the name of a city or state.”</p> <p>HP Network Virtualization for Mobile, Shunra vCat for Mobile Manual, Page 19-20, Ex. C.</p> <p>“APE — Best Practices</p> <p>Discovery: identify and record real-world infrastructure and network conditions, business processes, application topology and deployment scenarios.</p> <p>Pre-recorded library of global mobile and broadband network profiles enables rapid testing of mobile applications.</p> <p>Pre-recorded network profiles for emulating typical mobile and broadband network conditions between major global cities.”</p> <p>Built-in MySQL database stores thousands of network profiles.”</p> <p>Shunra NetworkCatcher, Page 2, Ex. F.</p>

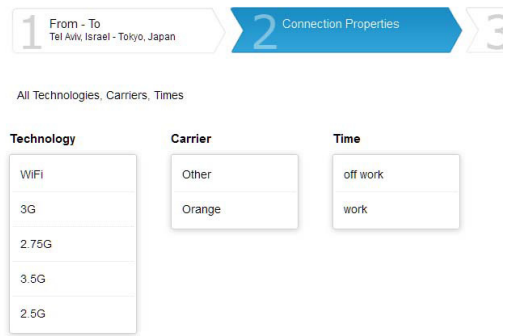
Claim 48, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
	<p data-bbox="562 256 1041 326">“Micro Focus Network Virtualization Network Performance Testing</p> <p data-bbox="562 367 1860 436">Capture and emulate real-world network conditions, so you can execute network performance testing to detect and remediate issues before app deployment.</p> <p data-bbox="562 477 831 513">Discover and capture</p> <p data-bbox="562 553 1860 623">Discover and capture live network performance conditions—such as latency, packet loss, bandwidth limitation and jitter—and recreate those conditions for network performance testing.”</p> <p data-bbox="562 696 1860 766">Micro Focus Corporate Website, available at https://software.microfocus.com/en-us/products/network-virtualization-for-load-testing/overview</p> <p data-bbox="562 839 1860 985">“Network Virtualization software allows you to discover and capture real-world network performance conditions from your production network, recreate network conditions in your lab during application testing, and optimize the applications to improve performance before you deploy into production.”</p> <p data-bbox="562 1026 1409 1062">Micro Focus Network Virtualization Data Sheet, Page 1, Ex D.</p>

Claim 48, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
	<p>“Use Network Capture to record and identify application performance problems occurring at a remote location, by measuring network conditions such as latency, packet loss, bandwidth availability across any given network topology. Network Capture can measure production links around the globe for a duration of up to one month.”</p> <p>HP Network Capture User Guide, Page 6, Ex E.</p> <p>“HP LoadRunner and HP Performance Center mobile testing protocols enable comprehensive performance testing of mobile applications for most mobile platforms—Android, iPhone®, Windows®, and others. Using the mobile protocols, the performance testing team is able to capture mobile traffic and generate realistic mobile load on the system under test.</p> <p>Features and benefits</p> <p>Shunra Network Virtualization enables an effective engineering methodology for application performance, providing the capabilities to discover real-world network conditions, virtualize those conditions in the test environment, analyze test results to isolate potential bottlenecks, and automatically deliver custom performance optimization recommendations. It provides:</p> <p>NetworkCatcher: The ability to automatically gather real-world network conditions, collecting interval statistics that include bidirectional bandwidth, latency, jitter, and packet loss conditions</p> <p>Global Library: Access to Shunra’s Global Library of mobile and broadband conditions provides up-to-date average, best-case, and worst-case network conditions from thousands of cities worldwide.”</p> <p>HP LoadRunner and HP Performance Center with Shunra Network Virtualization, Page 2-3, Ex. A.</p>

Claim 49 U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
<p>49. The system of claim 45, wherein the software can import real-world mobile network profiles from geographical locations worldwide.</p>	<p>Each Micro Focus-related Accused System is further configured to import real-world mobile network profiles from geographical locations worldwide.</p> <p>“Network Profiles . . . Profiles define the conditions for the test. They can be based on Shunra’s™ Global Library recordings, or can be set manually. . . . The imported profiles are recordings of mobile conditions between two points. These recording files are stored in the Shunra Global Library which is a regularly updated, pre-populated set of more than 15 million recorded real-world data points of point-to-point network conditions recorded around the world. . . . You can manually define specific network conditions for an individual test and then save the Profile to be used in other tests.”</p> <p>HP Network Virtualization for Mobile, Shunra vCat for Mobile Manual, Page 19, Ex. C.</p>  <p>The screenshot shows a configuration interface with three main sections: '1 From - To' (Tel Aviv, Israel - Tokyo, Japan), '2 Connection Properties', and '3'. Below these, there are three dropdown menus: 'Technology' (WIFI, 3G, 2.75G, 3.5G, 2.5G), 'Carrier' (Other, Orange), and 'Time' (off work, work). The text 'All Technologies, Carriers, Times' is visible above the dropdowns.</p> <p>“Micro Focus Network Virtualization Network Performance Testing</p> <p>Capture and emulate real-world network conditions, so you can execute network performance testing to detect and remediate issues before app deployment.</p>

Claim 49, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
	<p data-bbox="562 256 835 289">Discover and capture</p> <p data-bbox="562 329 1837 435">Discover and capture live network performance conditions—such as latency, packet loss, bandwidth limitation and jitter—and recreate those conditions for network performance testing.”</p> <p data-bbox="562 475 1837 548">Micro Focus Corporate Website, available at https://software.microfocus.com/en-us/products/network-virtualization-for-load-testing/overview</p> <p data-bbox="562 589 1837 727">“Network Virtualization software allows you to discover and capture real-world network performance conditions from your production network, recreate network conditions in your lab during application testing, and optimize the applications to improve performance before you deploy into production.”</p> <p data-bbox="562 768 1417 800">Micro Focus Network Virtualization Data Sheet, Page 1, Ex. D.</p> <p data-bbox="562 841 1837 979">“Use Network Capture to record and identify application performance problems occurring at a remote location, by measuring network conditions such as latency, packet loss, bandwidth availability across any given network topology. Network Capture can measure production links around the globe for a duration of up to one month.”</p> <p data-bbox="562 1019 1222 1052">HP Network Capture User Guide, Page 6, Ex. E.</p>

Claim 49, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
	<p data-bbox="562 329 1864 472">“HP LoadRunner and HP Performance Center mobile testing protocols enable comprehensive performance testing of mobile applications for most mobile platforms—Android, iPhone®, Windows®, and others. Using the mobile protocols, the performance testing team is able to capture mobile traffic and generate realistic mobile load on the system under test.</p> <p data-bbox="562 513 863 542">Features and benefits...</p> <p data-bbox="562 586 1864 729">Shunra Network Virtualization enables an effective engineering methodology for application performance, providing the capabilities to discover real-world network conditions, virtualize those conditions in the test environment, analyze test results to isolate potential bottlenecks, and automatically deliver custom performance optimization recommendations. It provides:</p> <p data-bbox="562 805 1864 873">NetworkCatcher: The ability to automatically gather real-world network conditions, collecting interval statistics that include bidirectional bandwidth, latency, jitter, and packet loss conditions</p> <p data-bbox="562 914 1864 982">Global Library: Access to Shunra’s Global Library of mobile and broadband conditions provides up-to-date average, best-case, and worst-case network conditions from thousands of cities worldwide.”</p> <p data-bbox="512 1024 1814 1092">HP LoadRunner and HP Performance Center with Shunra Network Virtualization, Page 2-3, Ex. A.</p>

Claim 49, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
	<p>The software is further configured to import real-world mobile network profiles.</p> <p>“Network Profiles</p> <p>Profiles define the conditions for the test. They can be based on Shunra’s™ Global Library recordings, or can be set manually.</p> <p>The imported profiles are recordings of mobile conditions between two points. These recording files are stored in the Shunra Global Library which is a regularly updated, pre-populated set of more than 15 million recorded real-world data points of point-to-point network conditions recorded around the world.”</p> <p>...In the From-To, select the Mobile and Server locations, such as the name of a city or state.”</p> <p>HP Network Virtualization for Mobile, Shunra vCat for Mobile Manual, Page 19-20, Ex. C.</p> <p>“APE — Best Practices</p> <p>Discovery: identify and record real-world infrastructure and network conditions, business processes, application topology and deployment scenarios.</p> <p>Pre-recorded library of global mobile and broadband network profiles enables rapid testing of mobile applications.</p> <p>Pre-recorded network profiles for emulating typical mobile and broadband network conditions between major global cities.”</p> <p>Built-in MySQL database stores thousands of network profiles.”</p> <p>Shunra NetworkCatcher, Page 2, Ex. F.</p>

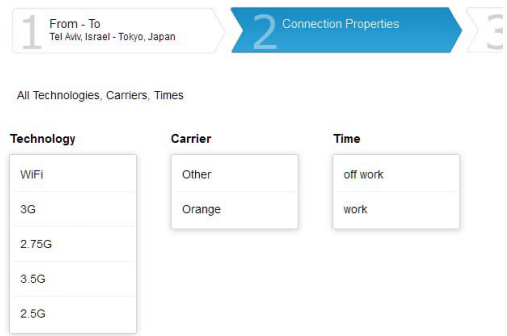
Claim 49, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
	<p data-bbox="562 256 1041 326">“Micro Focus Network Virtualization Network Performance Testing</p> <p data-bbox="562 367 1860 436">Capture and emulate real-world network conditions, so you can execute network performance testing to detect and remediate issues before app deployment.</p> <p data-bbox="562 477 831 513">Discover and capture</p> <p data-bbox="562 553 1860 623">Discover and capture live network performance conditions—such as latency, packet loss, bandwidth limitation and jitter—and recreate those conditions for network performance testing.”</p> <p data-bbox="562 696 1860 766">Micro Focus Corporate Website, available at https://software.microfocus.com/en-us/products/network-virtualization-for-load-testing/overview</p> <p data-bbox="562 839 1860 985">“Network Virtualization software allows you to discover and capture real-world network performance conditions from your production network, recreate network conditions in your lab during application testing, and optimize the applications to improve performance before you deploy into production.”</p> <p data-bbox="562 1026 1409 1062">Micro Focus Network Virtualization Data Sheet, Page 1, Ex D.</p>

Claim 49, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
	<p>“Use Network Capture to record and identify application performance problems occurring at a remote location, by measuring network conditions such as latency, packet loss, bandwidth availability across any given network topology. Network Capture can measure production links around the globe for a duration of up to one month.”</p> <p>HP Network Capture User Guide, Page 6, Ex E.</p> <p>“HP LoadRunner and HP Performance Center mobile testing protocols enable comprehensive performance testing of mobile applications for most mobile platforms—Android, iPhone®, Windows®, and others. Using the mobile protocols, the performance testing team is able to capture mobile traffic and generate realistic mobile load on the system under test.</p> <p>Features and benefits</p> <p>Shunra Network Virtualization enables an effective engineering methodology for application performance, providing the capabilities to discover real-world network conditions, virtualize those conditions in the test environment, analyze test results to isolate potential bottlenecks, and automatically deliver custom performance optimization recommendations. It provides:</p> <p>NetworkCatcher: The ability to automatically gather real-world network conditions, collecting interval statistics that include bidirectional bandwidth, latency, jitter, and packet loss conditions</p> <p>Global Library: Access to Shunra’s Global Library of mobile and broadband conditions provides up-to-date average, best-case, and worst-case network conditions from thousands of cities worldwide.”</p> <p>HP LoadRunner and HP Performance Center with Shunra Network Virtualization, Page 2-3, Ex. A.</p>

Claim 50 U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
<p>50. The system of claim 45, wherein the software enables a user to discover and import network conditions from geographical locations worldwide.</p>	<p>Each Micro Focus-related Accused System is further configured to enable a user to discover and import network conditions from geographical locations worldwide.</p> <p>“Network Profiles . . . Profiles define the conditions for the test. They can be based on Shunra’s™ Global Library recordings, or can be set manually. . . . The imported profiles are recordings of mobile conditions between two points. These recording files are stored in the Shunra Global Library which is a regularly updated, pre-populated set of more than 15 million recorded real-world data points of point-to-point network conditions recorded around the world. . . . You can manually define specific network conditions for an individual test and then save the Profile to be used in other tests.”</p> <p>HP Network Virtualization for Mobile, Shunra vCat for Mobile Manual, Page 19, Ex. C.</p>  <p>“Micro Focus Network Virtualization Network Performance Testing</p> <p>Capture and emulate real-world network conditions, so you can execute network performance testing to detect and remediate issues before app deployment.</p>

Claim 50, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
	<p data-bbox="562 256 835 289">Discover and capture</p> <p data-bbox="562 329 1837 435">Discover and capture live network performance conditions—such as latency, packet loss, bandwidth limitation and jitter—and recreate those conditions for network performance testing.”</p> <p data-bbox="562 475 1837 548">Micro Focus Corporate Website, available at https://software.microfocus.com/en-us/products/network-virtualization-for-load-testing/overview</p> <p data-bbox="562 589 1837 727">“Network Virtualization software allows you to discover and capture real-world network performance conditions from your production network, recreate network conditions in your lab during application testing, and optimize the applications to improve performance before you deploy into production.”</p> <p data-bbox="562 768 1417 800">Micro Focus Network Virtualization Data Sheet, Page 1, Ex. D.</p> <p data-bbox="562 841 1837 979">“Use Network Capture to record and identify application performance problems occurring at a remote location, by measuring network conditions such as latency, packet loss, bandwidth availability across any given network topology. Network Capture can measure production links around the globe for a duration of up to one month.”</p> <p data-bbox="562 1019 1218 1052">HP Network Capture User Guide, Page 6, Ex. E.</p>

Claim 50, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
	<p data-bbox="562 329 1864 472">“HP LoadRunner and HP Performance Center mobile testing protocols enable comprehensive performance testing of mobile applications for most mobile platforms—Android, iPhone®, Windows®, and others. Using the mobile protocols, the performance testing team is able to capture mobile traffic and generate realistic mobile load on the system under test.</p> <p data-bbox="562 513 863 542">Features and benefits...</p> <p data-bbox="562 584 1864 727">Shunra Network Virtualization enables an effective engineering methodology for application performance, providing the capabilities to discover real-world network conditions, virtualize those conditions in the test environment, analyze test results to isolate potential bottlenecks, and automatically deliver custom performance optimization recommendations. It provides:</p> <p data-bbox="562 805 1864 873">NetworkCatcher: The ability to automatically gather real-world network conditions, collecting interval statistics that include bidirectional bandwidth, latency, jitter, and packet loss conditions</p> <p data-bbox="562 914 1864 982">Global Library: Access to Shunra’s Global Library of mobile and broadband conditions provides up-to-date average, best-case, and worst-case network conditions from thousands of cities worldwide.”</p> <p data-bbox="514 1023 1816 1091">HP LoadRunner and HP Performance Center with Shunra Network Virtualization, Page 2-3, Ex. A.</p>

Claim 50, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
	<p>The software is further configured to import real-world mobile network profiles.</p> <p>“Network Profiles</p> <p>Profiles define the conditions for the test. They can be based on Shunra’s™ Global Library recordings, or can be set manually.</p> <p>The imported profiles are recordings of mobile conditions between two points. These recording files are stored in the Shunra Global Library which is a regularly updated, pre-populated set of more than 15 million recorded real-world data points of point-to-point network conditions recorded around the world.”</p> <p>...In the From-To, select the Mobile and Server locations, such as the name of a city or state.”</p> <p>HP Network Virtualization for Mobile, Shunra vCat for Mobile Manual, Page 19-20, Ex. C.</p> <p>“APE — Best Practices</p> <p>Discovery: identify and record real-world infrastructure and network conditions, business processes, application topology and deployment scenarios.</p> <p>Pre-recorded library of global mobile and broadband network profiles enables rapid testing of mobile applications.</p> <p>Pre-recorded network profiles for emulating typical mobile and broadband network conditions between major global cities.”</p> <p>Built-in MySQL database stores thousands of network profiles.”</p> <p>Shunra NetworkCatcher, Page 2, Ex. F.</p>

Claim 50, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
	<p data-bbox="562 256 1041 326">“Micro Focus Network Virtualization Network Performance Testing</p> <p data-bbox="562 367 1860 436">Capture and emulate real-world network conditions, so you can execute network performance testing to detect and remediate issues before app deployment.</p> <p data-bbox="562 477 831 513">Discover and capture</p> <p data-bbox="562 553 1860 623">Discover and capture live network performance conditions—such as latency, packet loss, bandwidth limitation and jitter—and recreate those conditions for network performance testing.”</p> <p data-bbox="562 696 1860 766">Micro Focus Corporate Website, available at https://software.microfocus.com/en-us/products/network-virtualization-for-load-testing/overview</p> <p data-bbox="562 839 1860 985">“Network Virtualization software allows you to discover and capture real-world network performance conditions from your production network, recreate network conditions in your lab during application testing, and optimize the applications to improve performance before you deploy into production.”</p> <p data-bbox="562 1026 1409 1062">Micro Focus Network Virtualization Data Sheet, Page 1, Ex D.</p>

Claim 50, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
	<p>“Use Network Capture to record and identify application performance problems occurring at a remote location, by measuring network conditions such as latency, packet loss, bandwidth availability across any given network topology. Network Capture can measure production links around the globe for a duration of up to one month.”</p> <p>HP Network Capture User Guide, Page 6, Ex E.</p> <p>“HP LoadRunner and HP Performance Center mobile testing protocols enable comprehensive performance testing of mobile applications for most mobile platforms—Android, iPhone®, Windows®, and others. Using the mobile protocols, the performance testing team is able to capture mobile traffic and generate realistic mobile load on the system under test.</p> <p>Features and benefits</p> <p>Shunra Network Virtualization enables an effective engineering methodology for application performance, providing the capabilities to discover real-world network conditions, virtualize those conditions in the test environment, analyze test results to isolate potential bottlenecks, and automatically deliver custom performance optimization recommendations. It provides:</p> <p>NetworkCatcher: The ability to automatically gather real-world network conditions, collecting interval statistics that include bidirectional bandwidth, latency, jitter, and packet loss conditions</p> <p>Global Library: Access to Shunra’s Global Library of mobile and broadband conditions provides up-to-date average, best-case, and worst-case network conditions from thousands of cities worldwide.”</p> <p>HP LoadRunner and HP Performance Center with Shunra Network Virtualization, Page 2-3, Ex. A.</p>

EXHIBIT A

Data sheet



HP LoadRunner and HP Performance Center with Shunra Network Virtualization

Improve the performance of mobile apps through effective testing



Demand for anywhere, anytime access to information has given rise to the mobile wave. As mobile applications continue to evolve into significant competitive differentiators, businesses are challenged to evolve continually and deploy applications that meet or exceed user expectations.

Performance testing is a critical step in the delivery of enterprise mobile applications. Because mobile applications have unique performance profiles, accurate performance testing can be challenging and elusive. Often, performance testing fails to incorporate the significant impact that mobile applications can have on the overall enterprise system. And when teams conduct mobile performance testing of their mobile applications, they often do not factor in the impact that the network can have on the user experience.

In the rush to create and release mobile applications, you should not overlook the effect of dynamic mobile network conditions on user experience. Deploying applications without testing against real-world network conditions cannot be an option—users should not be real-world testers, otherwise revenue, productivity, and brand image are at risk.

HP solves the mobile testing problem with a comprehensive solution for testing the performance of mobile applications. The solution is built with a combination of the tried and tested capabilities of HP LoadRunner software and HP Performance Center software, along with Shunra Network Virtualization capabilities.

The mobile performance testing solution of HP includes two new protocols:

- **HP Mobile TruClient**—Built on top of the innovative new HP TruClient technology, HP Mobile TruClient helps you record your browser-based applications directly through the browser. It makes scripting and testing of browser-based applications extremely fast, easy, and robust.
- **HP Mobile Applications**—For native mobile applications or for any other application that can't be recorded using HP Mobile TruClient, the HP Mobile Application protocol lets you build Web scripts by using agents on the device or through emulators.

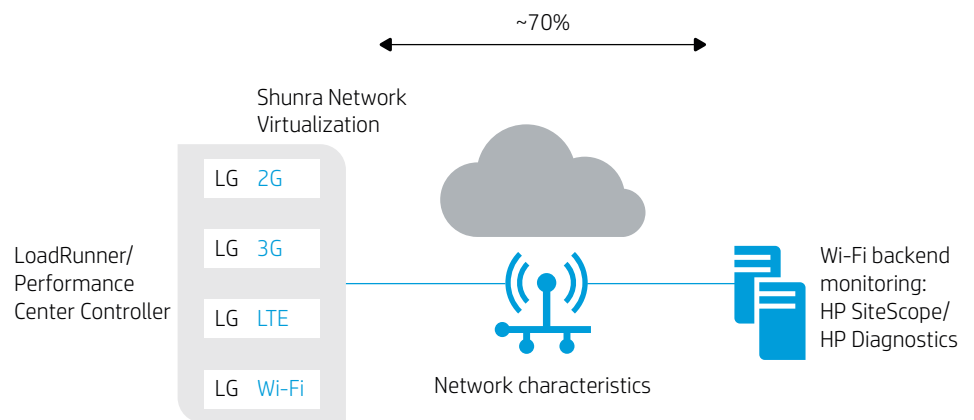
HP LoadRunner and HP Performance Center mobile testing protocols enable comprehensive performance testing of mobile applications for most mobile platforms—Android, iPhone®, Windows®, and others. Using the mobile protocols, the performance testing team is able to capture mobile traffic and generate realistic mobile load on the system under test.

Features and benefits

Shunra Network Virtualization, which integrates seamlessly into HP LoadRunner or Performance Center, enhances test accuracy by incorporating real-world network conditions into the load and performance test environment, ensuring that the test results are more reliable and accurate. From within the familiar HP software interface, you can leverage Shunra Network Virtualization to:

- Enable each load generator (LG) to emulate multiple different network location's transaction response time and reduce reliance on remote LGs
- Aggregate test results into a single database for ease and completeness of analysis
- Extend testing scripts with a single click
- Automate reporting and analysis for performance engineers, owners of lines of business, and other business constituents

Figure 1. Virtualize network conditions

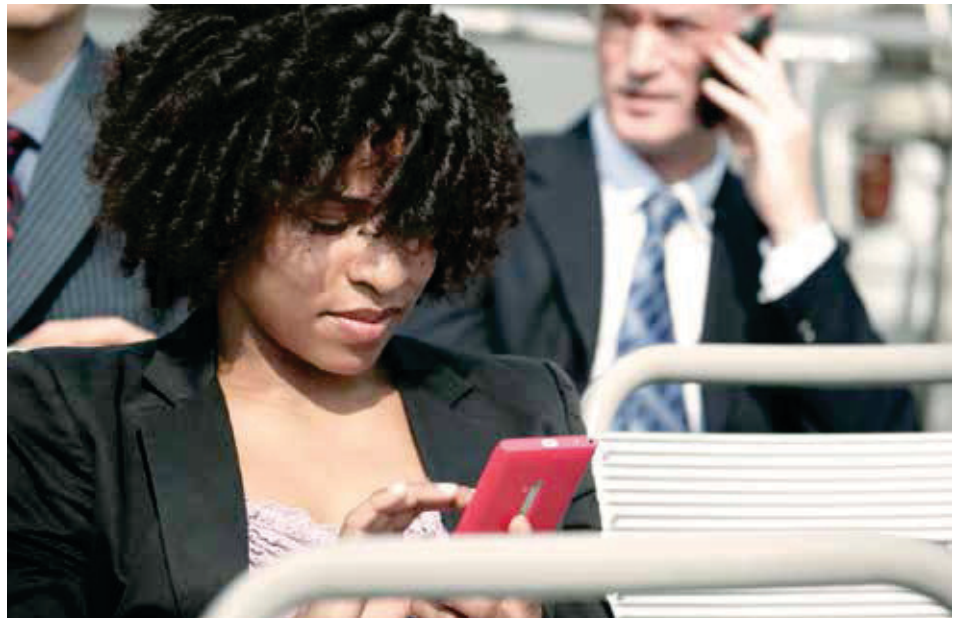


Shunra Network Virtualization enables an effective engineering methodology for application performance, providing the capabilities to discover real-world network conditions, virtualize those conditions in the test environment, analyze test results to isolate potential bottlenecks, and automatically deliver custom performance optimization recommendations. It provides:

- **NetworkCatcher:** The ability to automatically gather real-world network conditions, collecting interval statistics that include bidirectional bandwidth, latency, jitter, and packet loss conditions
- **Global Library:** Access to Shunra's Global Library of mobile and broadband conditions provides up-to-date average, best-case, and worst-case network conditions from thousands of cities worldwide
- **Shunra Analytics:** Highly accurate, deep-dive analytics, that provide location-specific performance information, including identification of poorly performing business transactions and the root cause of performance issues
- **Shunra Predictor:** Robust reporting and filtering of aggregated test data to analyze service levels from a per location, per connection type or per user segment perspective

Shunra Network Virtualization features easy configuration and use. It requires no script editing and places no limits on test scheduling. In addition, test results and data are automatically stored within HP results files and segregated by emulated location for precise, actionable analysis.

The combination of HP LoadRunner or Performance Center and Shunra Network Virtualization is the path to robust, reliable, and accurate mobile performance testing.



HP Services

Get the most from your software investment. We know that your support challenges may vary according to the size and business-critical needs of your organization.

HP provides technical software support services that address all aspects of your software lifecycle. This gives you the flexibility of choosing the appropriate support level to meet your specific IT and business needs. Use HP cost-effective software support to free up IT resources, so you can focus on other business priorities and innovation.

HP Software Support Services gives you:

- One stop for all your software and hardware services saving you time with one call 24x7, 365 days a year
- Offering you support for: VMware, Microsoft®, Red Hat, and SUSE Linux as well as HP Insight Software
- Fast answers giving you technical expertise and remote tools to access fast answers, reactive problem resolution, and proactive problem prevention
- Global Reach Consistent Service Experience giving global technical expertise locally

For more information go to hp.com/services/software-support.

Learn more at
hp.com/go/mobiletesting

Sign up for updates
hp.com/go/getupdated



Share with colleagues



Rate this document

© Copyright 2012–2013 Hewlett-Packard Development Company, L.P. The information contained herein is subject to change without notice. The only warranties for HP products and services are set forth in the express warranty statements accompanying such products and services. Nothing herein should be construed as constituting an additional warranty. HP shall not be liable for technical or editorial errors or omissions contained herein.

Microsoft and Windows are U.S. registered trademarks of Microsoft Corporation. iPhone® is a trademark of Apple Inc.

4AA4-2925ENW, October 2013, Rev. 1



EXHIBIT A--134

EXHIBIT B

Data sheet

HP Network Virtualization for Mobile



Network virtualization for software testing



HP Network Virtualization for Mobile is the only network virtualization solution designed specifically for the unique requirements of mobile app testing. Based on technology acquired from Shunra, this field-proven HP solution reduces the risk of poor mobile performance and helps your organization test, validate, and optimize the performance of your mobile apps before deployment.

Mobile network optimization has never been easier

Mobile is a critical channel for customer communication and represents a significant competitive advantage in today's always-on, always-connected world. But with mobile, you only have one chance to make a first impression, and end-user patience is waning.

Just 250 milliseconds of delay can negatively impact your revenue, productivity, customer loyalty, and brand. Your business cannot afford to take that chance. With HP Network Virtualization for Mobile, you have a proven technology that has been shown to reduce the occurrence of performance incidents by more than 25%.

Built on the HP Network Virtualization engine, HP Network Virtualization for Mobile bridges the gap between development and deployment by enabling your mobile application development team to fully and accurately assess the behavior and impact of the network on mobile apps before they are introduced to end users. By virtualizing real-world mobile network conditions within testing environments, your test results are more reliably predictive of how an application will behave for end users.



HP Network Virtualization for Mobile allows tests to be managed and results analyzed from any laptop or Wi-Fi-connected mobile device. The software can import real-world mobile network profiles captured by HP Network Capture or provided by the HP Network Virtualization Library of mobile and broadband network conditions.

The robust analytic capabilities in HP Network Virtualization for Mobile provide deep-dive root cause analysis of performance bottlenecks, a mobile performance scorecard, and automated optimization recommendations that have been proven to improve mobile app performance by more than 40%.

Mobile profiles

The HP Network Virtualization Library provides a library of real-world mobile and broadband network conditions.

Import Profile

1 From - To
Chicago, IL, US - Los Angeles, CA, US

2 Connection Properties

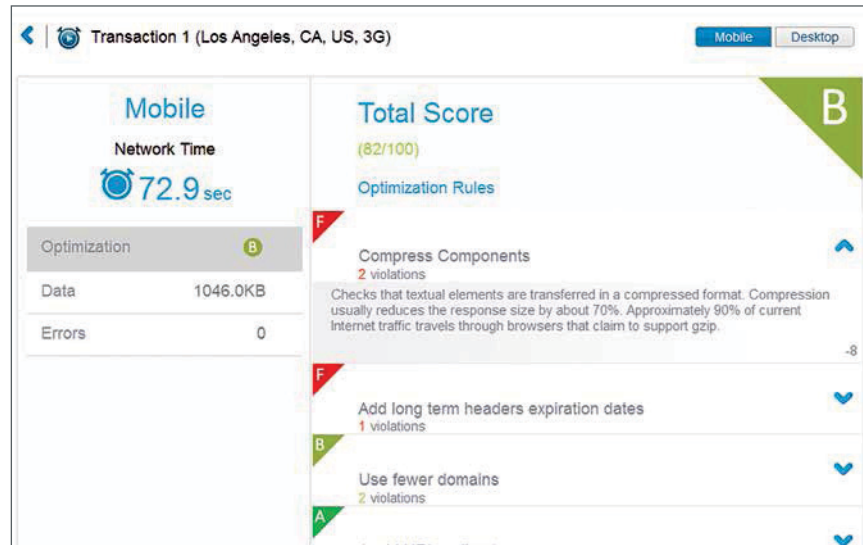
3 Finish

All Technologies, Carriers, Times

Technology	Carrier	Time
WiFi	AT&T	Business hours
2.5G	Sprint	Off hours
2.75G	T-Mobile	
3G	Verizon	
3.5G	Other	
3.75G		

Transaction response times

HP Network Virtualization for Mobile measures and scores transaction response times.

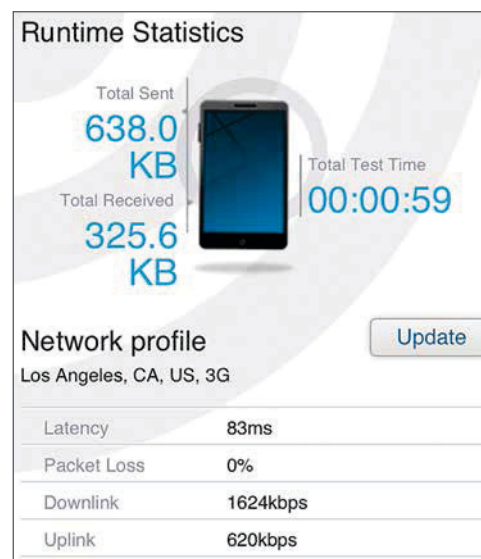
**Why HP Network Virtualization for Mobile?**

Because over 70% of the performance of a mobile app is dependent on the network, your organization must consider the effect of the mobile network on the end-user experience before an app is deployed. Every second of delay increases user abandonment, sends traffic to competitive sites and applications, and decreases the likelihood those users will return.

By virtualizing real-world mobile network conditions in the test environment, performance test results are reliably predictive of actual application behavior. You can test, validate, remediate, and achieve mobile app optimization before deployment to verify that your back-end capacity and end-user experience requirements are met before deployment.

Runtime statistics

HP Network Virtualization for Mobile provides total control and visibility over mobile network conditions and usage.



Key features

HP Network Virtualization for Mobile delivers capabilities designed to improve your organization's ability to create a reliable mobile app testing environment, analyze performance test results, and take immediate and effective action to both remediate problems and optimize mobile app performance. Key features of HP Network Virtualization for Mobile include:

Multi-flow capability

Because mobile network conditions are dynamic and vary by carrier, location, and time of day, it is essential for testing environments to accurately recreate multiple mobile network scenarios in order to analyze app performance and determine how network conditions affect different mobile users. The multi-flow capability in HP Network Virtualization for Mobile allows you to define a mobile test scenario that simultaneously emulates multiple user locations, each with its own unique set of virtualized mobile network conditions.



Decode HLS streams

Delivering streaming video across mobile networks is challenging because constantly changing conditions can impact the user experience. As a result, organizations are turning to HTTP Live Streaming (HLS), which supports multiple alternate streams to be delivered at different bit rates and enables client software to intelligently switch streams based on changes in network bandwidth. HP Network Virtualization for Mobile can decode and analyze HLS streams as a standard part of its HTTP analysis capabilities.

HP Application Performance Analytics

As a standalone analysis engine, HP Application Performance Analytics allows your testers to analyze all HP Network Virtualization files. In addition, HP Application Performance Analytics supports standard PCAP files, extending deep-dive analysis capabilities to those PCAP files generated by other applications.

Enhanced reports

New reports that detail resource breakdown, endpoint latencies, and analysis of secure HTTP communications provide insight into latency for each host and "top-talker," so your testers can now verify that tests are routed correctly and ensure they are aware of all resources or hosts.

Remote operation

Emulation control, packet capture, and statistics can be managed and viewed via a REST-based API and CLI. Access to HP Network Virtualization for Mobile is not restricted to a single workstation as it is specifically designed to operate in a shared testing environment, with multiple users accessing the technology at different times.

Learn more at

hp.com/go/nvmobile

Sign up for updates
hp.com/go/getupdated



Share with colleagues



Rate this document



EXHIBIT C



vCat for Mobile Manual v8.5
Application Performance Engineering

Copyright Notice

© 2012 Shunra Software Ltd. Shunra is a trademark of Shunra Software Ltd. All rights reserved.

This document is for information purposes only. Shunra Software Ltd. makes no warranties, expressed or implied. Shunra, the Shunra logo, PerformanceSuite, vCat and all other Shunra product or technology names are trademarks or registered trademarks of Shunra Software Ltd.

Microsoft, Visio and Windows are either registered trademarks or trademarks of Microsoft Corporation in the United States and/or other countries. Other brand and product names are trademarks or registered trademarks of their respective holders.

Information in this document is subject to change without notice and does not represent a commitment on the part of Shunra Software Ltd. The software described in this document is furnished under license agreement. The software may be used only in accordance with the terms of this agreement.

No part of this manual may be reproduced or transmitted in any form or by any means, for any purposes other than the purchaser's personal use, without the express written permission of Shunra Software Ltd.

Legal notice of related license agreements is located in the Installation folder.

Corporate Headquarters

1800 JFK Boulevard
Philadelphia PA 19103
USA
Tel: (215) 564 4046
Fax: (215) 564 4047
Sales: 1 877 474 8672
Support: 1 267 519 5137
email: info@shunra.com

European Office

73 Watling Street
London EC4M 9BJ
Main: +44 (0)207 153 9835
Fax: +44 (0)207 785 6816
Sales: +44 (0)207 153 9835
Support: +44 (0)207 1539838
email: saleseurope@shunra.com

Israel Office

PO Box 7372
Hod Ha'sharon
Israel 45240
Tel: +972 9 764 3743
Fax: +972 9 764 3754
Sales: +972 9 763 4227
Support: +972 9 763 4227
email: info@shunra.com

Table of Contents

Chapter 1 vCat for Mobile Introduction . . . 1 - 1

vCat for Mobile	1 - 1
Network Editor	1 - 1
Transaction Manager	1 - 1
Shunra Analytics	1 - 2

Chapter 2 Installing and Configuring vCat for Mobile 2 - 1

System Requirements	2 - 1
Setting up the Testing Environment	2 - 2
vCat for Mobile Installation	2 - 3
Changing the vCat for Mobile Port	2 - 3
Upgrade	2 - 4
Silent Installation	2 - 4
Silent Uninstall	2 - 5
vCat for Mobile Licensing	2 - 5
Log Files	2 - 8

Chapter 3: Conducting Network Virtualization 3 - 1

Viewing and Setting the Active Adapter	3 - 1
Conducting Tests in Multi-User Mode	3 - 2
HTTP Port Settings	3 - 2
Network Profiles	3 - 3
Devices	3 - 6
Starting a Test from a Device	3 - 8
Starting a Test from the Multi-User Console	3 - 8
Viewing Runtime Information	3 - 10
Runtime Updates	3 - 10
Transaction Marking	3 - 11
Deleting Tests	3 - 13
Switching between Multi-User and Single-User Mode	3 - 14

Conducting Network Virtualization in Single-User Mode . . .	3 - 14
The Cleanup Threshold	3 - 15
The Perfmon Counters	3 - 16

Chapter 4: Using the Shunra Network Editor . 4 - 1

Installing the Network Editor4 - 1
Opening the Network Editor4 - 1
Creating Shunra Emulation Profiles4 - 2
Setting Client and Server IP Ranges	4 - 4
Defining Packet List Settings	4 - 5
Configuring Gateway Parameters	4 - 5
Configuring the WAN Shape	4 - 8

Chapter 5 vCat for Mobile Web Service API . 5 - 1

Emulation Services5 - 1
Start New Emulation	5 - 2
Workaround to work with XML format	5 - 5
Start New Emulation – Advance Mode	5 - 7
Real Time Update	5 - 8
Real Time Update for Advance Mode	5 - 11
Get Emulation Parameters	5 - 12
Stop Emulation	5 - 17
Force Stop Emulation	5 - 17
Get Emulation Tokens	5 - 18
Get Statistics	5 - 19
Start PacketList Capture – Specific and Global	5 - 28
Stop Packet List Capture – Specific and Global	5 - 29
Is PL Capturing	5 - 30
Get Packet List IDs	5 - 31
Download Packet List	5 - 32
Download External Events File	5 - 33
Traffic Resource Files	5 - 34
Configuration Services	5 - 36
Set Active Adapter	5 - 36

Get Active Adapter	5 - 37
Add Exclude IP/PORT Range	5 - 38
Remove Exclude IP/PORT Range	5 - 39
Get All Exclude IP/PORT Ranges	5 - 40
Get Version Info	5 - 41
Set Configuration	5 - 42
Get Configuration	5 - 43
Transaction Manager	5 - 44
Connect	5 - 44
Disconnect	5 - 45
StartTransaction	5 - 46
StopTransaction	5 - 48
License Manager	5 - 49
Get Installed Products' Information	5 - 49
Get Local License Servers	5 - 56
Checkout License from the Local License Server	5 - 59
Check-in License to the Local License Server	5 - 61

Chapter 5: vCat for Mobile Command Line Interface 6 - 1

Commands	6 - 1
DownloadExternalEvents	6 - 2
DownloadShunraFile	6 - 2
SetConfiguration	6 - 3
StartAdvanceEmulation	6 - 4
GetActiveAdapter	6 - 4
GetEmulationParameters	6 - 4
DownloadPL	6 - 4
GetExcludeRanges	6 - 5
SetActiveAdapter	6 - 5
GetServerConfiguration	6 - 5
StopEmulation	6 - 6
StartCapture	6 - 6
StopCapture	6 - 6
IsCapturing	6 - 6

UpdateEmulation	6 - 7
StartEmulation	6 - 7
GetIdentifiers	6 - 7
ResetDriver	6 - 7
DeleteExcludeRange	6 - 8
AddExcludeRange	6 - 8
GetPacketListIds	6 - 9
GetProductVersion	6 - 9
UpdateAdvanceEmulation	6 - 9
DeleteAllExcludeRanges	6 - 10

Chapter 7 Network Emulation Specifications . 7 - 1

1

vCat for Mobile Introduction

vCat for Mobile™ virtualizes real-world mobile network conditions within testing environments, making test results more reliably predictive of how an application will behave for end users. It is comprised of the following components:

vCat for Mobile

vCat for Mobile tests application performance under a variety of current and potential network and mobile conditions. In Multi-User Mode many users can run network virtualization tests simultaneously and run tests directly from mobile devices, in addition to stationary devices. Embedded transaction marking and a direct connection to Shunra's Global Library is also provided. In Single-User Mode, tests can include multiple flows.

vCat for Mobile is equipped with a REST API and a CLI that facilitate the remote management of tests and integration with load tools.

Network Editor

The Network Editor, used in Single-User Mode, defines simple and complex network scenarios by creating and modifying scripts to emulate your specific network conditions. These files can be defined in the Network Editor, or recordings can be obtained from the Shunra NetworkCatcher and saved in the .ntxx format.

Transaction Manager

Shunra's Transaction Manager used in Single-User Mode, marks transaction times in vCat for Mobile tests that can be used to identify the transactions in Shunra Analytics and note transaction response times.

Shunra Analytics

Shunra Analytics assists in pinpointing factors that negatively impact an application's operation across a network. Shunra Analytics conducts an analysis based on test results generated using vCat for Mobile in both modes, then displays the resulting data in informative reports that provide insight into an application's operation. Shunra Analytics enables the identification and diagnosis of the sources of poor performance.

2

Installing and Configuring vCat for Mobile

This section provides information regarding the installation, configuration and setup and licensing of vCat for Mobile, including.:

- ◆ **System Requirements:** ([page 2-1](#)) lists system requirements for host machines
- ◆ **vCat for Mobile Installation:** ([page 2-3](#)) provides instructions on how to install vCat for Mobile
- ◆ **Upgrade during silent install can be enabled and client data is retained.:** ([page 2-4](#)) provides instructions on how to conduct a silent installation of vCat for Mobile
- ◆ **Silent Uninstall:** ([page 2-5](#)) provides instructions on how to conduct a silent uninstallation of vCat for Mobile
- ◆ **vCat for Mobile Licensing:** ([page 2-5](#)) provides instructions on how to obtain a license for vCat for Mobile

System Requirements

The minimum requirements for vCat for Mobile and Network Editor are as follows:

Processor	Dual core processor or higher
Memory	2 GB RAM (minimum), 4 GB RAM (recommended)
Hard Disk	20 GB of free disk space
Network Adapter	1 Gigabit Ethernet adapter; note that Multi-User mode or certain Single-User mode scenarios require 2 Gigabit Ethernet adapters

Desktop Operating System (English Version only)	Win 7 SP1 (32/64 bit) Server 2008 SP2 (32/ 64 bit) Server 2008 R2 SP1 (64 bit) Server 2003 SP2 (32/64 bit) Server 2003 R2 SP2 (32/64 bit) XP Professional SP3 (32 bit) XP Professional SP2 (64 bit)
---	---

Browsers	Firefox 10 and higher Chrome 17 and higher Internet Explorer 9.0 and higher
-----------------	---

Mobile Operation Systems	iOS: 5.x and higher Android: 2.2 and higher
---------------------------------	--

Note: WinPcap 4.1.2 must be installed prior to installation of vCat for Mobile.

The following prerequisites will be installed during the installation if not already present:

- Java Runtime Environment 6.0 update 24 (32 bit); 7.0 (32 bit) also supported
 - Microsoft .NET Framework 4.0 Full
-

Setting up the Testing Environment

The vCat for Mobile machine should be deployed and used as a router between the clients' network and the server's network.

The networks must be configured so that traffic between the clients and server under test will pass through the vCat for Mobile machine.

NAT devices cannot be placed between the client(s) participating in the tests and the vCat for Mobile machine.

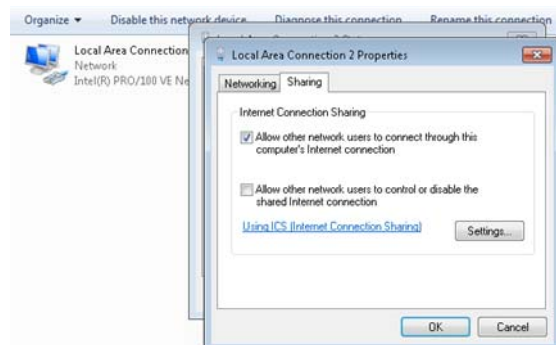
Refer to the Deployment Best Practices document.

Enabling Windows ICS (Internet Connection Sharing)

Windows ICS (Internet Connection Sharing) routes traffic between the two network adapters and provides NAT.

To Enable Windows ICS:

- 1** From the Control Panel, open Network and Internet > Network and Sharing Center; in the Internet area two network connections should be active.
- 2** Open the Local Area Connection on the Server (side adjacent to the server or Internet).
- 3** Select Properties > Sharing.
- 4** Enable ICS by selecting "Allow other network users to connect through this computer's Internet connection" and click OK.

**vCat for Mobile Installation**

To install vCat for Mobile, open the, and follow the directions in the Setup; reboot required.

Note: The system time, time zone and daylight savings settings must be synchronized for Shunra Analytics to be able to conduct analysis. In addition, the time settings must be synchronized with the Shunra License Server machine's settings.

Changing the vCat for Mobile Port

By default, vCat for Mobile uses port 8182.

To change the port:

- 1** Ensure that no emulations are currently running.
- 2** Open the configuration folder, by default C:\Program Files\Shunra\conf
- 3** Open the file: vCat.properties
- 4** Change:

com.shunra.vcat.port=8182

to

com.shunra.vcat.port="X"

- 5 Save the file.
- 6 Open the config.properties
- 7 Change:
 - ❖ com.shunra.bootstrapper.port="X"
- 8 Restart the services:
 - ❖ Shunra Watchdog
 - ❖ Shunra Performance Counters
- 9 To access vCat for Mobile applications, in the browser change the port for the Multi-User console, Network Editor and License Manager.

Upgrade

Upgrade during silent install can be enabled and client data is retained.

To upgrade from vCat v7.0 and earlier:

- 1 Uninstall vCat, then install vCat for Mobile v8.5. **To upgrade from vCat v8.0:** Open the vCatSetupWizard.exe, and follow the instructions.
- 2 Copy existing result folders, by default:
 - ❖ \\%ProgramData%\Shunra\vCat for Mobile or
 - ❖ \\%AppData%\Shunra\vCat for Mobile
 To the results folder selected in the Setup, by default:
 - ❖ \\%ProgramData%\Shunra\vCat for Mobile\Runs
 - ❖ or \\%AppData%\Shunra\vCat for Mobile\Runs.

Silent Installation

vCat for Mobile can be installed (and uninstalled) silently.

Note: When performing silent installation of vCat client, you must be logged in as a local Administrator.

Verify that all system requirements are met before beginning installation. You will not be notified if silent installation fails.

To silently install vCat for Mobile:

- 1 Copy the file vCat_setup.exe to a convenient location.

- 2 From the Start menu, choose Run; then type CMD.

In the Command window, navigate to the location of the file copied in step 1, and type: `vcac_setup.exe /s /v"PORT=<port number> [INSTALLDIR=\"<path to install dir>\"] [ENABLE_REMOTE=TRUE | FALSE] [REBOOT_IF_NEED=TRUE | FALSE] [DATA_FOLDER=\"<path to data dir>\"]"`

Note: the port used by Analytics is used by the vCat for Mobile if already installed; ENABLE_REMOTE adds the port to the firewall

Example:

```
vcac_setup.exe /s /v"/qn PORT=8182
ENABLE_REMOTE=TRUE"
```

Note: Even if the if the ENABLE_REMOTE=FALSE option is used during installation, the machine will need to be rebooted before vCat is operational.

Silent Uninstall

vCat for Mobile can be uninstalled silently.

Note: When performing silent uninstallation of vCat for Mobile, you must be logged in as a local Administrator.

To silently uninstall vCat for Mobile:

- 1 From the Start menu, choose Run; then type CMD.
- 2 Type:

```
vcac_setup.exe /s /removeonly /v" [PORT=<port
number>] [REBOOT_IF_NEED=TRUE | FALSE] "
```

PORT - optional, removes the port from the firewall

vCat for Mobile Licensing

vCat for Mobile licensing provides various options for licensing. Initially, vCat for Mobile comes with a fully-featured evaluation license of 2 days.

Depending upon your license agreement, you can:

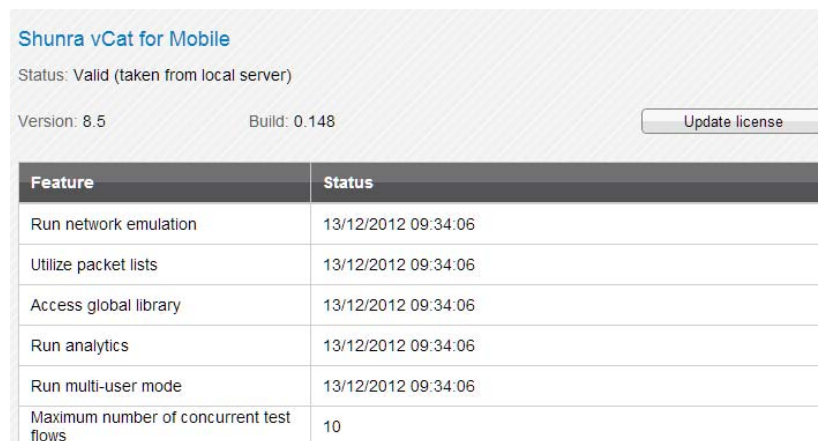
- ◆ Upload a license file (see **To upload a license file:**)
- ◆ Check out a license for a limited period from a local license server (see **To check out a license from a local license server (online):**)

For information about installing the Shunra License Server, refer to the Shunra License Server Installation and Configuration document.

To access the Shunra License Manager:

- 1** From the Start menu (**Start > Programs > Shunra**) select **Shunra License**.

The status of the license is displayed.



Feature	Status
Run network emulation	13/12/2012 09:34:06
Utilize packet lists	13/12/2012 09:34:06
Access global library	13/12/2012 09:34:06
Run analytics	13/12/2012 09:34:06
Run multi-user mode	13/12/2012 09:34:06
Maximum number of concurrent test flows	10

To upload a license file:

- 1** Select the **Update License** button.
- 2** In the **Update via**, select the **File** radio button.
- 3** Select **Download product key** and save the fingerprint file (.c2v) on the local machine.

Update Shunra vCat for Mobile 8.5 license

Update via:

☒ File ☐ Local licensing server

License file (.V2C)

Update

To obtain a license file:

1. Download the Product Key
2. Send an email to: license@Shunra.com and attach your Product Key

- 4 Attach the product key file (.c2v) to an email message and sent to license@shunra.com
Or
Select **Send Shunra your customer details and attach product key** to attach the license file.
- 5 After the license file (.V2C) is received from Shunra, save the updated key file on the local machine.
- 6 Select the folder icon beside the File box and download the (.V2C) file.
- 7 Click **Update**. The updated license details are displayed in the Shunra License Manager main page.

Note: If vCat for Mobile is open in a browser window, after updating the license close and reopen the window.

To check out a license from a local license server (online):

Note: The offline method must be used when the license client cannot communicate with the licensing server using TCP port 1947; refer to the Shunra vCat License Server Installation and Configuration Guide.

- 1 From Start > Programs > Shunra, open the Shunra License Manager (local-host:8182/Shunra/license).
- 2 Select the **Update License** button.
- 3 Select **Local licensing server** radio button.

- 4 In the Local server address, select the machine on which the license server is installed. If the License Server does not appear in the list, but is reachable using TCP port 1947, type the license server hostname or IP in the Local server address box.
- 5 Enter the number of days required in the License duration box, and click Checkout license. The updated license details are displayed in the Shunra License Manager main page.

Note: If vCat for Mobile is open in a browser window, after updating the license close and reopen the window.

To check in a license to a local license server (online):

- 1 From Start > Programs > Shunra, open the Shunra License Manager (local-host:8182/Shunra/license).
- 2 Select the **Update License** button.
- 3 Select **Local licensing server** radio button.
- 4 Click **Return license**.

Log Files

Shunra products' log files are located by default in \Program Files or \Program Files (x86)\Shunra\logs.

The vCat for Mobile Agent writes to the System Event log if errors occur; the source name is VCatLogSource.

3

Conducting Network Virtualization

vCat for Mobile provides network virtualization on mobile and stationary devices, and includes integrated transaction marking, view of running statistics and Performance Highlights reports.

vCat for Mobile can run in two modes, but not simultaneously:

- ◆ **Multi-User mode:** to conduct tests directly from mobile and stationary devices; more than one user can run tests simultaneously. To leverage this mode, you will normally want to configure your system as a router.
- ◆ **Single-user mode:** to conduct tests that include single or multiple flows, but are run by a single user. In this mode, the system that is running vCat for Mobile may operate as a router to test multiple devices, or vCat for Mobile can impair applications running locally in the same execution environment that is running vCat for Mobile.

The vCat for Mobile Agent displays the status of both modes as either running or not running (see **Conducting Network Virtualization in Single-User Mode** on [page 3-14](#)).

Viewing and Setting the Active Adapter

The Active Adapter determines the NIC through which impairments are applied to the traffic and packets are captured.

When the vCat for Mobile machine routes traffic between clients (such as a mobile device) and a server, select the adapter that is on the Client side.

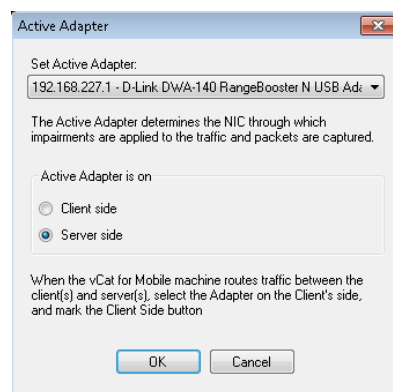
When the transactions are conducted on the vCat for Mobile PC (when the vCat for Mobile PC is the client), and if more than one adapter is present, select the adapter that is used to access the Server(s) associated with the test.

To view and set the Active Adapter:

- 1 Open the vCat for Mobile Agent (Start > Programs > Shunra > vCat for Mobile > vCat Agent).

Note: The vCat Agent is located in the Notifications and Icons area in the taskbar when active.

- 2 In the vCat for Mobile Agent, select **Set Active Adapter**.



- 3 If required select another adapter from list. Select the required Adapter and mark Client Side or Server Side (see explanation above).

Conducting Tests in Multi-User Mode


Multi-User mode provides for testing scenarios in which multiple users can conduct independent tests simultaneously, from various devices. Many users can run tests on their mobile and/or stationary devices simultaneously and perform a HTTP analysis from these devices.

The Multi-User Console web interface provides management functions such as monitoring and controlling devices, tests and network profiles. You can conduct tests on mobile devices and view the throughput on the device; tests can also be managed from the Multi-User console.

HTTP Port Settings

vCat for Mobile analyzes the HTTP traffic that traverses port 80 (default port).

To add or modify the port settings:

- 1 Click the Settings icon .
- 2 Add or modify the required ports, each separated by a comma.

**Network Profiles**

Profiles define the conditions for the test. They can be based on Shunra's Global Library recordings, or can be set manually.

The imported profiles are recordings of mobile conditions between two points. These recording files are stored in the Shunra Global Library which is a regularly updated, pre-populated set of more than 15 million recorded real-world data points of point-to-point network conditions recorded around the world.

You can manually define specific network conditions for an individual test and then save the Profile to be used in other tests.

To import a Profile:

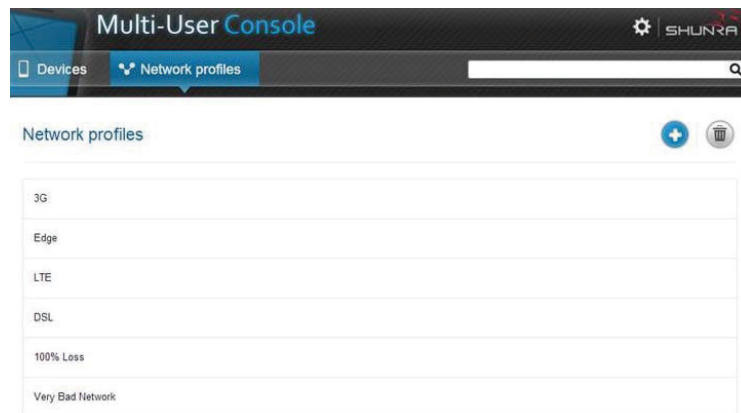
- 1 In the Network Profiles tab the following general profiles are displayed (these profiles are already imported and do not require Internet access):
 - ❖ **3G:** latency 75 ms, download 780 Kbps, upload 330 Kbps, packet loss 0%
 - ❖ **Edge:** latency 200 ms, download 100 Kbps, upload 100 Kbps, packet loss 0%
 - ❖ **LTE:** latency 40ms, download 10,000 Kbps, upload 7500 Kbps, packet loss 0%
 - ❖ **DSL:** latency 25ms, download 2000 Kbps, upload 256 Kbps, packet loss 0%
 - ❖ **100% Loss:** latency 0 ms, download 10000 Kbps, upload 10000 Kbps, packet loss 100%

3-4

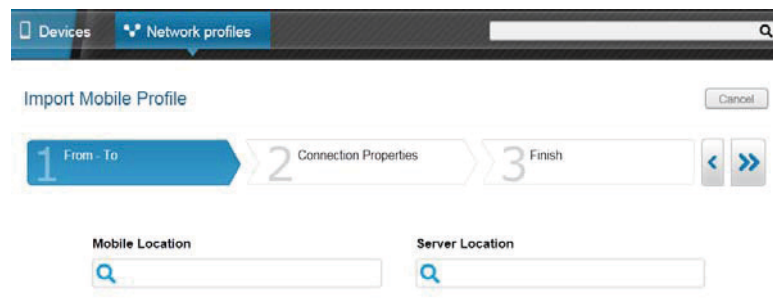
vCat for Mobile Manual
Chapter 3

- ❖ **Very Bad Network:** latency 500 ms, download 1000 Kbps, upload 1000 Kbps, packet loss 10%

- 2 To import a different profile from the Shunra Global Library, click "+" (internet access required).



- 3 In the From-To, select the Mobile and Server locations, such as the name of a city or state.



- 4 In the Connection Properties, define the Technology, Carrier and Time of day.

Note: The Technology and Carrier are related to the Client Location.

1 From - To
Tel Aviv, Israel - Tokyo, Japan

2 Connection Properties

All Technologies, Carriers, Times

Technology	Carrier	Time
WiFi	Other	off work
3G	Orange	work
2.75G		
3.5G		
2.5G		

5 Select the forward arrows and choose one of the Communication quality options.

6 If a WiFi connection was selected, select the required bandwidth.

Communication quality

- ☐ poor
☒ fair
☐ good

Profile name

Tel Aviv, Israel - Tokyo, Japan, fair

7 Select the check mark to import the Profile.

After the success message displays, the profile can be used in tests (it will be listed in the Network Profiles area when defining a test).

To define a Custom Network Profile:

1 In the Start new test page, Network Profile Custom tab, enter values for the following:

- ❖ Latency (between 0-8000 ms)
- ❖ Packet loss (between 0-90%)
- ❖ Bandwidth (between 2.4 - 10,000,000 Kbps)

Network profile

Predefined Custom

Latency: 22 ms

Packet loss: 22 %

Bandwidth: Unlimited Kbps

Save as profile

Start cancel

- 2** Click **Save as profile** to be able to use in additional tests (this example shows Network Profiles on a mobile phone).

Cancel Start new test Start

Network Profile

Saved Custom

London, United Kingdom - San Francisco, California, US, 3G, Orange, work, good

London, United Kingdom - San Francisco, California, US, 3G, Orange, work, good

A

A

Custom: Latency: 22, Loss: 22, BW: Unlimited

Custom: Latency: 10, Loss: 0, BW: 6144

my 535464\$%#\$%\$% # 535

Custom: Latency: 10, Loss: 0, BW: 6144

Cancel

Navigation icons: back, forward, share, book, list

Devices

From the Welcome page, by default the Devices page displays the registered devices including the running and idle devices; the Icon and List view can be toggled with the icons at the top.

Note: You can search for a device using the Search bar at the top.

To add a device:

- 1 To add a device from the Multi-User Console (for example when registering a number of devices at the beginning a project), in the Devices page, click the "+" icon at the top right.
- 2 Click the "Click here" link in the page.



- 3 In the Add Device page, select a device type and enter the Device name.



- 4 Click **Add**.

To delete a device:

Devices can only be deleted from the Multi-User Console.

- 1 In the Devices page, select the device.
- 2 Click the Delete device button (at the top right).

Starting a Test from a Device

When starting a test using Multi-User mode on a mobile or stationary device, no prior configuration is required.

To start a test from a device:

- 1 In a supported browser(see **System Requirements** on [page 2-1](#)), type:
`http://<vCat for Mobile host IP>:8182/shunra/mobile`

Note: Port 8182 is used by default; to change the port, see **Changing the vCat for Mobile Port**, [page 2-3](#).

- 2 If the Device Registration page displays, connect as an Registered device; for new devices, select **Add New Device**.
- 3 Click **Start New Test**.
- 4 Select **Capture packets** if analysis is required (the packet list is essential for analysis, which uses the packet list data to produce the analytics reports and recommendations).
- 5 Depending upon how you are going to conduct transaction marking, deselect or leave the **Mark transaction per network profile** selected, see **Network Profiles**.
- 6 Select or define a Network Profile.
- 7 Select **Start**. Conduct the required transactions (see **Transaction Marking**).
- 8 Select **Stop** at the completion of the test.

Starting a Test from the Multi-User Console

To run a test from the Multi-User Console, select a Registered device, or register a new device.

To start a test from the Multi-User Console:

- 1 Click the device icon, and then click **Start New Test**.

- 2 In the Start New Test page, enter the device's IP.

Note: To determine your mobile device's IP, on the device check the Wireless Settings/Properties. The IP is automatically detected when starting a test from a Device.

- 3 Select **Capture packets** if analysis is required. The packet list is essential for analytics, which use the packet list data to produce the analytics reports and recommendations.

Note: For Packet Capture configuration, see **Packet Capture Buffer Settings**([page 3-9](#)).

- 4 Select or define a Network Profile.
- 5 Depending upon how you are going to conduct transaction marking, deselect or leave the **Mark transaction per network profile** selected; see **Network Profiles**.
- 6 Select **Start**.
- 7 Conduct the required transactions (see **Transaction Marking**).
- 8 Select **Stop** at the completion of the test.

Packet Capture Buffer Settings

The PacketListMaxSizeMB defines the maximum size of the packet list buffer (comprises all devices in a test). The default maximum size is 300 MB (note that the buffer cannot be more than 25% of the RAM).

When "IsPacketListCaptureCyclic" is set to 'true' (default setting), results overwrite existing results when the buffer is full. When 'IsPacketListCaptureCyclic' is set to 'false', new results are not retained when the buffer is full.

To change the Packet Capture buffer settings:

- 1 Stop any network virtualizations that are currently running.
- 2 Open the configuration folder, by default
C:\Program Files\Shunra\conf
- 3 Open the file: userconfig
- 4 Change: 'PacketListMaxSizeMB' to the required value.
- 5 Save the file.
- 6 Restart the service: Shunra Watchdog

Viewing Runtime Information

When a test is running, information including throughput is displayed in the Running now tab. The Tested network profiles area displays all profiles used in the test.

To view runtime information:

- 1 On the Multi-User Console, from the Devices page, select the Device. Information is displayed in the Running now area.

Runtime Updates

You can update Network Profiles while the test is running, from the device and from the Multi-User Console.

To change the Network Profile in a running test:

- 1 From the Device, select the **Update** button.
Or
In the Multi-User Console > Device page, click the link below Network profile (blue).

Test 5		<button>stop</button>			
Device IP	Network profile	Test Time	Sent data	Received data	Packets
192.168.227.101	Custom: Latency - 80.0, Loss - 5.0, BW - Unlimited	00:01:13 Started at 11.11.2012 16:47	0 B	0 B	Recording

- 2 Select another Predefined profile or change the metrics in a Custom profile.
- 3 Select the **Update** button.

Transaction Marking

When transactions are not marked, the packet list capture file will not have markers to denote the beginning and end of each transaction, and the analytics will only show one large transaction. In this case it is difficult to draw conclusions from the analytics results that can be used to improve application performance.

Therefore, in vCat for Mobile, transactions are created automatically every time the profile is updated and 'Mark transaction per network profile', the default setting, is selected.

However, for testers who prefer to mark transactions according to the action, such as a login, manual transactions are also available. A manual transaction overrides the a 'Mark transaction per network profile' feature for the duration of the test.

Manual transaction timing is conducted via the Multi-User Console and on the device, which means that the transaction is started and stopped on the Multi-User Console, but the transaction is conducted on the device.

To mark transactions:

- 1 In the Multi-User Console, when a test is running, select Start Transaction.
- 2 Perform the transaction on the device.
- 3 When the transaction has completed, click the Stop transaction icon.

Note: The transaction can be deleted and the transaction name is editable until the test is completed.

Performance Highlights Report

Tests in which packets were recorded are saved; the Capture packet option must be enabled and there must be at least one complete client-to-server transaction to an application server.

The Performance Highlights report displays certain results after a test, including the total performance score of the transaction, individual optimization

rules categorized for Mobile or Desktop, data breakdown and errors. Analysis is only conducted on the HTTP related traffic.

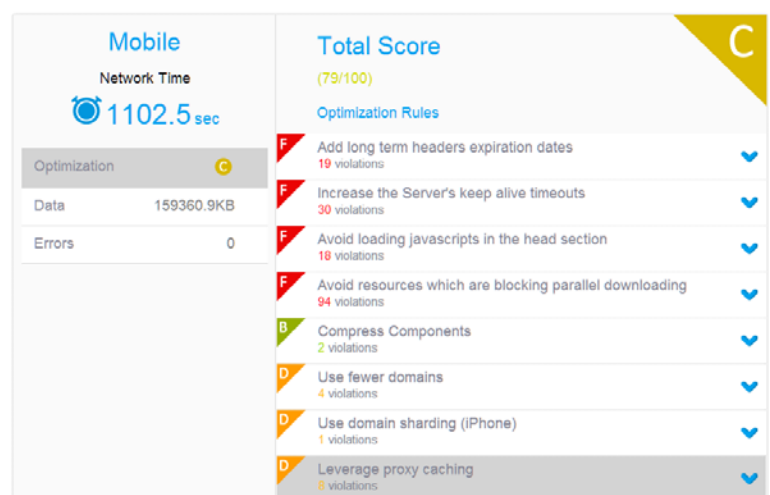
For additional analytics results, including precise performance data such as load times, component download analysis, response time breakdown etc., use Shunra Analytics. Note that results in the Performance Highlights may differ somewhat from the results in the Shunra Analytics, as the Performance Highlights detects additional rule violations.

The Total Duration shows the time from when a the start of a transaction is marked until the end of the transaction is marked, either in the UI or via the API. In the **Performance Highlights Report**, the Network Time is the duration between the first packet in the transaction until the last packet in the transaction.

Note: The Network Time displayed in Shunra Analytics for the same transaction may be longer since Shunra Analytics also analyzes non-HTTP traffic.

To view test results:

- 1 In the Completed tests list, select the required test.
- 2 If more than one transaction is present, select the required transaction.
The **Performance Highlights Report** displays.



Saving Test Results for Shunra Analytics

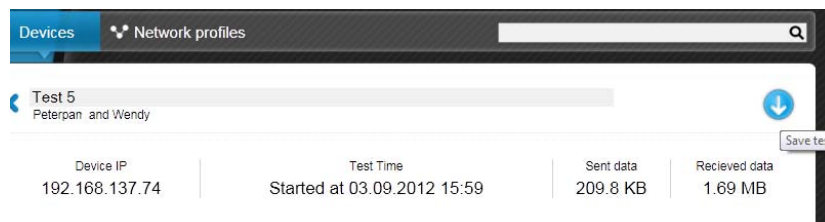
To download test results:

- 1 In the Multi-User Console, Devices page, click the required device's icon.
- 2 In the results list, click the required test.
- 3 Click the arrow (top-right) and save the .shunra file. This file can be imported into Shunra Analytics once downloaded.

Results are downloaded from the %ProgramData%\Shunra\VCat for Mobile\Runs or %AppData%\Shunra\VCat for Mobile\Runs.

To change the location of the results folder:

- 1 Ensure that no emulations are currently running.
- 2 Open the configuration folder, by default C:\Program Files\Shunra\conf
- 3 Open the file: vcat.properties
- 4 Change:
com.shunra.vcat.datafolder=C:\ProgramData\Shunra\VCat for Mobile\Runs (or %AppData%\Shunra\VCat for Mobile\Runs)
to
com.shunra.vcat.datafolder="X"
- 5 Save the file.
- 6 Restart the service: Shunra Watchdog
- 7 Move any results files to the new location.



Deleting Tests

To delete some or all tests:

- 1 In the Devices page, click the Delete button.
- 2 Select certain tests, or select the "Completed tests" radio button to delete all results.

- 3 Click the check mark to delete, or the "x" to cancel.

Switching between Multi-User and Single-User Mode

Multi-User and Single-User Mode cannot run simultaneously; therefore to switch between modes, stop the mode either via the UI or the API.

Note: To determine if either mode is running, open the vCat for Mobile Agent from the Start menu or System Tray. It will be in the System Tray if it has been opened. If a test is running, the vCat for Mobile Agent displays with a green icon; the tooltip indicates if it is running in Multi-User or Single-User Mode.

To stop Multi-User mode from the UI:

- 1 Stop all tests, either from the devices or from the Multi-User Console.

Note: Stopping Multi-User mode using the API or vCat for Mobile Agent will delete all currently running tests.

To stop either mode using the vCat for Mobile Agent:

- 1 Select Stop in the vCat for Mobile Agent menu.

To stop either mode using the API:

- 1 Use the Force Stop Emulation command (refer to **Force Stop Emulation** on [page 5-17](#)).

Conducting Network Virtualization in Single-User Mode

The vCat for Mobile Agent displays the status of network virtualizations running in Single-User mode or Multi-User mode (when a network virtualization is running, the Stop option is available).

To conduct a network virtualization in Single-User Mode:

- 1 In the vCat for Mobile Agent (Start > Programs > Shunra > vCat for Mobile > vCat Agent).
- 2 If you have a profile (.ntxx) you can import a network virtualization file. To define a new virtualization scenario refer to [Chapter 4, Using the Shunra Network Editor](#). The .ntxx file can include a number of flows to emulate a variety of locations and/or conditions.

To conduct a test with an .ntxx file, in the vCat Agent, select **Start test from profile...** option.

- 3 Click **Start test...** to define Latency, Packet Loss and/or Bandwidth parameters. Select **Capture packets (Client side)** to use the packet list data to produce the analytics reports and recommendations.

The screenshot shows a 'Test Parameters' dialog box with the following settings:

- Latency (ms): 0 (range 0 - 8000)
- Packet Loss (%): 0 (range 0 - 90)
- Bandwidth (Kbps): Unrestricted (range 2.4 - 10000000)
- ☒ Capture packets (Client side)
- Buttons: Start Test, Cancel

OR

Click **Start test from profile....** to import the network conditions and settings.

- 4 Conduct the transactions using the Shunra Transaction Manager (see the Shunra Transaction Manager manual); for automation, see **vCat for Mobile Web Service API**.
- 5 After the test has completed, click **Stop**. The **vCat for Mobile** Agent continues to run in the Taskbar until **Exit** is selected.
- 6 Select **Yes** to stop the emulation, or **Yes and Copy** to save the results file (.shunra) to a second location in addition to the default Results folder selected in the installation.
- 7 This file can be imported into Shunra Analytics; for further information, refer to the Shunra Analytics manual.

The Cleanup Threshold

The Cleanup Threshold is a mechanism for deleting network virtualization results to free up disk space before starting a network virtualization.

Test results are saved in the vCat for Mobile Data folder as defined during setup (by default in %appdata%\Shunra\vCat for Mobile\Runs or %program-data%\Shunra\vCat for Mobile\Runs).

When starting an emulation, if the defined free disk threshold isn't met, the results folders will be deleted one by one from the oldest until the threshold is restored, or until only two folders are left.

If only two folders are left and the threshold wasn't restored the emulation will not start, consider deleting unnecessary data or reducing the threshold.

The required available disk space (the threshold) is equal to the calculation of these values:

`'MinNumOfPaketListSpace' x 'PacketListMaxSizeMB'`

Where:

PacketListMaxSizeMB: the maximum size of the packet list (comprises all devices in a test).

MinNumOfPakectListSpace: a positive integer

For example:

If `MinNumOfPakectListSpace=3`, the packet list maximum size is 100MB, and there are more than two results folders, the Cleanup Threshold would be activated if the available disk space were less than 300 MB.

The Cleanup Threshold is activated if `'IsCleanupEnabled'` to `'true'` and the other conditions are met. Messages will appear both in the vCat for Mobile Agent and also will be written in logs.

To modify the Cleanup Threshold:

- 1** Ensure that no emulations are currently running.
- 2** Open the configuration folder, by default `C:\Program Files\Shunra\conf`
- 3** Open the file: `vcat.properties`
- 4** Set `'IsCleanupEnabled'` to `'true'` or `'false'` to enable or disable Cleanup.
- 5** If required, modify `'PacketListMaxSizeMB'` to the required value.
- 6** If required, modify `'MinNumOfPakectListSpace'` to the required value.
- 7** Save the file.
- 8** Restart the service: Shunra Watchdog

The Perfmon Counters

The Perfmon Counters provide runtime information on each vCat for Mobile flow on which network virtualization is performed.

Note: If these counters are not visible, ensure that the following MS Windows services are running:

- Remote Registry
- Performance Logs and counters
- Performance Counter DLL Host (MS Windows 2008 only)

To setup the network virtualization monitors:

- 1** From the Start menu select **Run**; open **Perfmon**.
- 2** Click **Add**.
- 3** In the Add Counters window, right-click **Add Measurements**.

The **Shunra Client** and **Shunra Server** counters display the following statistics:

Counter Name	Counter Description
Bandwidth Util In %	Percentage of outgoing bandwidth used by this location during the last second
Bandwidth Util Out %	Percentage of incoming bandwidth used by this location during the last second
Current bps In	Number of bits sent by this location during the last second
Current bps Out	Number of bits received by this location during the last second
Total Throughput In (bytes)	Total throughput sent by this location.
Total Throughput Out (bytes)	Total throughput received by this location.

Shunra Cloud: Provides wide area network measurements of the Shunra emulation.

Counter Name	Counter Description
Latency (msec)	Average latency in the Network during the last second

3-18

vCat for Mobile Manual
Chapter 3

Packet Loss %	Packet Loss percentage in the Network during the last second
Packet Loss Count	Packet loss count in the Network during the last second
Packet Loss Total	Packet Loss during the entire test

4

Using the Shunra Network Editor

The Shunra Network Editor is used to create and edit network scenario files for Single-User mode. Each network scenario file can contain multiple flows, in which each flow represents traffic between two locations or different networks.

The Network Editor model is based upon a network in which the client and server are each adjacent to a gateway. For easy identification, the network file editor calls these gateways "Server Gateway" and "Client Gateway." Data flows between the Client Gateway and the Server Gateway through the WAN. These values can be:

- ◆ Manually set in the various parameter tabs of the Network Editor ([page 4-8](#))
- ◆ Imported from Shunra NetworkCatcher recordings

Installing the Network Editor

The Network Editor is installed as part of the vCat for Mobile installation, see [Chapter 2 Installing and Configuring vCat for Mobile](#).

Opening the Network Editor

To open the Network Editor:

- 1 From the Start menu > Shunra > vCat for Mobile> Shunra Network Editor
OR
In a browser, type:
`http://<vCat for Mobile IP>:8182/shunra/networkeditor/`

Creating Shunra Emulation Profiles

A network scenario file emulates network conditions with parameters such as packet loss, latency and bandwidth limitation of the virtualized network.

The network scenario file defines the network conditions between two end-points. You can set a series of parameters that characterize the gateways and the WAN. For example, you can set values that represent network phenomena such as latency and packet loss, or hardware settings such as the size of the queues allowed on the gateway.

The output of the Network Editor is stored in a .ntxx file.

Note: The output of the Network Editor is stored in a (.ntxx) file; files from releases of the Network Editor (.ntx) prior to v8.0 cannot be played in vCat for Mobile. To play a file from a previous version, edit it in the Network Editor; when saved it will be in the .ntxx format. If there are incompatible elements, error messages will indicate what should be modified so that the file can be used.

The file can be saved on a shared directory for use by vCat for Mobile users testing emulated network conditions. The appropriate file is sent to each load generator as part of load test initialization. Thus, the individual load generators do not need to be configured to access a shared directory of files.

Note: The .ntxx files created by the Network Editor cannot be imported into Shunra's PerformanceSuite.

To create a Shunra Emulation Profile (.ntxx file):

Note: Each file can contain multiple flows provided that the IPs do not overlap.

- 1** On the home page, select **New**.
- 2** Click **Add new flow**.

3 In the New Flow page, set the following parameters as described below:

- ❖ **Setting Client and Server IP Ranges:** (page 4-4) the gateway and its parameters including bandwidth limitations, and packet overhead using configured data or imported values
- ❖ **Configuring Gateway Parameters:** (page 4-5) assists in applying emulation parameters between specific IP addresses
- ❖ **Configuring the WAN Shape:** (page 4-8) : set latency and packet loss parameters using imported data, or by configuring values

4 After selecting the required options, click **Done**.

The Flow Summary displays all Flows. To edit a file click the pencil icon; to delete a file click the "x"; to delete all files select the table icon.

Flow Summary

Flow	Client	Client Gateway		WAN		Server Gateway	
Name	IP Range	Upstream	Downstream	Latency	Packet Loss	Upstream	Downstream
New Flow	<div><div><div>• Include: 1.0.0.10 - 1.0.0.100, All protocols, Any port</div><div>Excluding:</div><div>1.0.0.50 - 1.0.0.51, All protocols, Any port</div><div>1.0.0.77 - 1.0.0.80, All protocols, Any port</div></div></div>	50kpps	25kpps	Type: Uniform Values: Minimum: 0ms Maximum: 0ms Latency Change: 0	Type: Client Values: Good State Loss: 0.1% Good State Change: 1% Bad State Loss: 0.1% Bad State Change: 1%	Unrestricted	Unrestricted
New Flow 1	<div><div><div>• Include: 3.0.0.10 - 3.0.0.100, All protocols, Any port</div><div>Excluding:</div><div>3.0.0.30 - 3.0.0.35, All protocols, Any port</div><div>3.0.0.77 - 3.0.0.78, All protocols, Any port</div><div>3.0.0.80 - 3.0.0.81, All protocols, Any port</div></div></div>	Unrestricted	Unrestricted	Type: Linear Values: Minimum: 0ms Maximum: 0ms Duration: 1sec	Type: Burst Values: Loss Probability: 1% Minimum: 1 Maximum: 1	Unrestricted	Unrestricted

- 5 Select **Save** to download the network profile to the browser's default download folder.

Note: It is highly recommended to configure the browser to prompt the user to choose the folder at download time.

- 6 The file can be imported into the vCat for Mobile Agent to conduct a network virtualization.

Setting Client and Server IP Ranges

Network impairments can be limited to and from specified IP addresses (to "include" them) or to refrain from affecting traffic to certain addresses ("exclude" them). Network traffic that is not included in the emulation will not be impaired, and will not be included in monitoring reports.

To include or exclude IP addresses:


- 1 In the **Client IP Ranges** tab, click the "+" icon.

Note: Exclude the address of the machine on which the Network Editor is installed.

- 2 Select a Port and Protocol (optional) and click **OK**.
- 3 Repeat steps 2-3 for all the IP addresses to include or exclude.

An IP address can be modified by selecting it and clicking the pencil icon; an IP address can be removed from the list by selecting it and clicking the "x" icon.

The Server IP can be ignored, in which case the complete IP Range is used.

The Server's Sync button  includes the IP Range 1.0.0.0-255.255.255.255 and excludes the flow's Client ranges to prevent ambiguous routes.

To exclude specific IP Ranges in all running tests:

- 1** Ensure that no emulations are currently running.
- 2** Use the Web Services API or the CLI (refer to **vCat for Mobile Web Service API** and **vCat for Mobile Command Line Interface**).
- 3** Restart the service: Shunra Watchdog

Defining Packet List Settings

The packet list is essential for Shunra Analytics, which use the packet list data to produce the analytics reports and recommendations.

To enable Packet List capture:

- ◆ In the Packet List icon (located between the Client and Client Gateway), select **Enable packet list capture**, then click **Close**.

Configuring Gateway Parameters

Gateway parameters emulate the behavior of access gateways on real networks. For example, you can specify the bandwidth or queue limitation a specific gateway imposes on the network. Entering gateway parameters is optional, and the options are the same for both the Client and the Server gateways. The gateway element represents an actual gateway that can be separately configured for incoming and outgoing traffic. Click the Client and Server Gateway tabs to configure the parameter settings.

- ◆ **Bandwidth Settings**

- ◆ **Queue Settings:** ([page 4-7](#))

Bandwidth Settings

Bandwidth values can be defined or imported from a recording file; upstream and downstream may each have different values.

Note: The following instructions are valid for both the upstream and downstream settings.

To define the bandwidth values:

- 1 Select **Predefined**, then choose a preset value (these settings corresponds to common bandwidth settings such as T1, etc.), OR
Select **Custom**, then type a value to select a specific bandwidth (values between 2.4 and 10,000,000 Kbps).



- 2 Click **Done**.

Importing Bandwidth Settings

Bandwidth recordings of up to 900 samples can be imported; the imported file is validated, so that incorrect values are not saved.

To import recorded bandwidth parameters:

- 1 In the Client and/or Server Gateway tab, select **Recorded** then click **Choose file**.



- 2 In the Browse window, select the relevant file. Files which do not contain valid bandwidth parameters are not imported.

Queue Settings

The Queue Settings define the queue limitations and packet overhead.

Queue Limitation

This group contains parameters that emulate limitations imposed on the maximum size of IP packet queues at the gateway NIC. If you specify a queue size, vCat for Mobile emulates network behavior by dropping data packets when the queue is full.

Check the Queue Limitation box in order to access these parameters:

Parameter	Description
Queue Size	Select the amount of memory (KB) that the vCat for Mobile will allocate to the queue.
Drop Mode	
Drop Tail	Select this option for the vCat for Mobile to drop newer data packets when the queue is full.

Parameter	Description
Random Early Detection (RED)	This option provides a more sophisticated queue management method. The RED algorithm keeps track of the average increase in queue occupancy. If it detects an increase, it signals to the packet source that the queue may soon be full, by randomly dropping very small amounts of data packets. In the Keep Queue size between fields, indicate the minimum and maximum average occupancy. The system issues signals (by dropping data packets) when the average occupancy fluctuates between the two values. It drops all packets if the average occupancy exceeds the maximum threshold.
Fill mode	Use fixed size: 1500 for each packet Use actual packet size

Packet Overhead

If your gateway adds overhead bytes to the IP data that flows through the gateway NIC, use this parameter to specify the number of additional bytes, in order to emulate the bandwidth consumption they impose on the network.

To enable packet overhead:

- 1 Check the **Packet Overhead** box.
- 2 Select:
 - ❖ Ethernet (add 18 bytes to each packet)
 - ❖ PPP (add 9 bytes to each packet)

Configuring the WAN Shape

Note: Packet Effects and Link Faults are always set manually.

This section reviews how to set phenomena such as packet loss, latency, dynamic routing effects, and disconnections:

- ◆ **Latency and Packet Loss:** (page 4-9): the latency defines the time it takes an IP packet to cross the WAN; the packet loss determines how many packets are dropped according to different types of calculations

- ◆ **Packet Effects:** (page 4-12): dynamic IP packet routing effects, including out-of-order packets (reordering), duplicated packets, and packet fragmentation
- ◆ **Link Faults:** (page 4-14): possible damages to bit streams and possible network disconnections

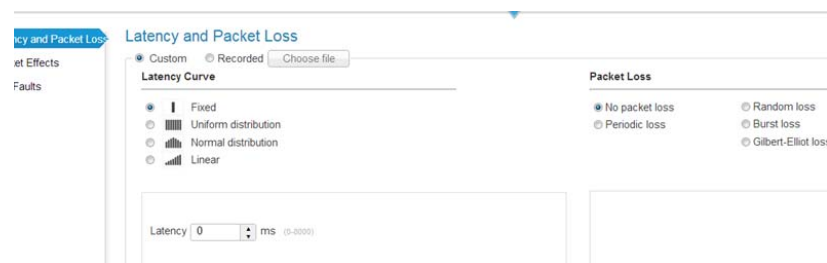
Latency and Packet Loss

Latency is the time it takes an IP packet to cross the WAN. In the Network Editor you can define a fixed latency or a statistically distributed latency. Via a fixed latency, you can emulate a simple WAN. For complex networks, a distributed latency yields a more accurate emulation. Set Latency and Packet Loss parameters using the following modes:

- ◆ **Custom:** to set the latency and packet loss manually
- ◆ **Recorded:** to import a recording of network settings

To set Latency and Packet Loss parameters:

- 1 From the WAN tab, select **Latency and Packet Loss**. To set the parameters manually, skip to Step 3.



- 2 To import a recording, select **Recorded** and then click **Choose file**. In the Browse window select the file. In addition select from the following playback options:

Play imported values sequentially

While emulating the network, the vCat for Mobile will cyclically use the latency values one after the other in the order in which they were recorded.

Play imported values randomly

While emulating the network, the vCat for Mobile will pick one of the recorded values randomly, for each packet. This allows you to experience random values from the real network to predict more network scenarios.

Multiply latency values by, Multiply packet loss values by

The Playback Factor allows you to predict future load cases or to prepare some margins of service level over the current status.

In these fields, you can specify a number between 0 and 200 percent to have the latency and packet loss values multiplied by it. The value of 100% means that the vCat for Mobile will use the recorded values as they are. The value 200 means that each value will be doubled (multiplied by 200%).

3 To define the settings manually, select the **Custom** radio button.

4 To set the Latency values, select one of the following options:

◆ **Fixed Latency:** type the number of milliseconds from 0 to 8000 ms

◆ **Uniform distribution:** specifies a changing latency over time (also referred to as jitter). Type the minimum and maximum latency values in the Minimum and Maximum boxes. This causes vCat for Mobiles to randomly change the latency between the minimum and maximum values (from 0 to 8000 ms).

You can limit the change in latency between each two consecutive packets to a specified number. To use this option, check the **Limit latency change** box and enter the maximum allowed change in milliseconds. For example, if you enter 45, the vCat for Mobile will change the latency by a maximum of 45 milliseconds between two consecutive packets.

◆ **Normal distribution:** This option causes latency to fluctuate randomly and non-uniformly around an average value (milliseconds) that you specify in the Average box. This option can be used to emulate jitter conditions.

The Standard Deviation parameter allows you to exert some control over the random change in latency. Entering a value in this parameter sets a range for two thirds of the random values. For example, if the average is 600 milliseconds and the standard deviation is 100 milliseconds, two thirds of random latency values will be between 500 and 700.

- ◆ **Linear Latency:** This option allows you to set a range of latency values and to indicate the time it takes latency to increase from the minimum to the maximum value in the range.

Enter the range in Minimum and Maximum (from 0 to 8000 ms), and the cycle duration in Graph duration (from 1 to 65535 seconds). For example, if you define a range of 100 to 200 milliseconds and a cycle duration of 100 seconds, the vCat for Mobile will increase latency by one millisecond each second.

When the vCat for Mobile reaches maximum latency, it cycles back to the minimum value.

To integrate packet loss into the scenario, select a Packet Loss option:

Note: Packet loss can also be imported in a recorded file.

- ◆ **No Packet Loss:** Select this option if the WAN behavior you want to emulate is not affected by packet loss. In this case, the vCat for Mobile does not lose any packets and the impairment is not applied to network traffic.
- ◆ **Periodic Loss:** Select this option and enter a number (from 2 to 65535) in the **Lose one packet every x packet** box, to instruct the vCat for Mobile to discard every xth packet that passes through the emulated WAN. For example, if you enter 8, the vCat for Mobile discards every 8th packet that enters the WAN.
The vCat for Mobile counts packets separately in both directions. It loses the incoming xth packet and the outgoing xth packet.
- ◆ **Random Loss:** This option allows you to set the probability for losing each packet (enter a percentage from 0.01 to 90). For example, entering 2 means that each packet has a 2 percent chance of being dropped while passing through the emulated WAN.
- ◆ **Burst Loss:** This option allows you to introduce a "bursty" packet loss model in the emulated WAN, by setting a number of packets to lose (burst size) every time a loss event occurs. You can specify the probability

of the loss event (Burst Probability), and the Minimum and Maximum parameters (from 1 to 65535 packets) that specify a range for the random size of each packet loss burst.

- ◆ **Gilbert-Eliot Loss:** This model states that, in terms of packet loss, some networks experience two states: good and bad. You can emulate a good and bad state by specifying an average packet loss percentage in the **Loss** parameter of the two states (from 0.01% to 100%).

In Change State, you specify the chances that the network will leave the specific state and move to the other (from 0.01% to 99.99%). For example, if the tested network has, at any given time, a 10% chance of moving from good to bad and a 50% chance of moving from bad to good, you specify 10 and 50 in the respective Change State fields.

Packet Effects

vCat for Mobile can emulate IP routing effects such as disruption of packet order (reordering), packet duplication, and fragmentation, via parameters defined in the **Packet Effects** tab.

Packet Effects

☒ **Out of Order**

- Chance % (1-50)
- Packet offset from original location: Minimum Packets (1-64), Maximum Packets (1-64, Minimum < Maximum)

☒ **Duplicate Packets**

- Chance % (1-99)
- Number of duplicated packets created: Minimum Packets (1-20), Maximum Packets (1-20, Minimum < Maximum)

☒ **Fragmentation**

- Chance % (1-99)
- Maximum transmission unit Bytes (64-1460)
- ☐ Ignore 'do not fragment' (df) bit
- ☒ Generate ICMP error message to source
- ☐ Do not generate ICMP error message to source

To instruct the vCat for Mobile to emulate packet effects, check the box of the effect you want to emulate, and configure the parameters:

- ◆ **Out of Order:** To emulate packet reordering, the vCat for Mobile can generate an out-of-order event, based on the probability set in the **Chance** parameter (from 1% to 50%), by randomly removing a packet from the data stream. Then it starts counting the incoming packets. It returns the removed packet after the nth packet has entered the vCat for

Mobile. The nth packet is picked randomly from the range that you indicate in the Maximum and Minimum (Packet offset from original location) parameters (from 1 to 64 packets). For example, if you indicate a range of 5 to 10, the vCat for Mobile will return the removed packet randomly to the data stream (after the 5th, or 6th...or 10th packet that follows the removed one). In order to have the vCat for Mobile return all removed packets after a predefined number of incoming packets, the same value can be used for both Minimum and Maximum offset.

- ◆ **Duplicate Packets:** The vCat for Mobile emulates duplication by copying a packet that it selects randomly. The number of copies that will be created when the event occurs is specified in the Minimum and Maximum parameters (from 1 to 20 packets). For example, if you specify a range of 2-4 packets, the vCat for Mobile duplicates a packet 2, 3, or 4 times (randomly), when it decides to do so (according to the probability specified in Chance- from 1% to 99%). To instruct the vCat for Mobile to create a pre-defined number of copies, enter the same value in both the Minimum and Maximum parameters. For example, entering 3 in both parameters causes the vCat for Mobile to create 3 copies of the packet when the event occurs.
- ◆ **Fragmentation:** To emulate the packet fragmentation effect you need to set a packet size, in bytes, in the Maximum Transmission Unit parameter (from 64 to 1460 bytes). This would be the maximum size a gateway along the path route would allow (MTU). Bigger packets are likely to be fragmented or discarded when the fragmentation event occurs (according to the probability set in Chance- from 1% to 99%). Whether or not the packets will be eventually fragmented depends on the state of the Do Not Fragment (DF) bit in the packet's IP header and on the policy you define via the options included in the Fragmentation group. If the flag is OFF, the packet is fragmented anyway. If the flag is set to ON, the policy you select applies.

A description of the DF=ON policies is as follows:

Option	If DF is ON, instructs vCat for Mobile to
Ignore Do Not Fragment (DF) bit	Fragment the packet.

Option	If DF is ON, instructs vCat for Mobile to
Generate ICMP Error Messages to Source	Discard the packet and inform the packet's source, using an ICMP packet.
Do Not Generate ICMP Error Messages	Discard the packet without informing the packet's source.

Link Faults

Link faults consist of effects caused by physical link malfunctions, specifically bit errors and disconnections. Bit errors are emulated by instructing the vCat for Mobile to toggle bits at a given frequency. To achieve "disconnection" in the WAN you can instruct the vCat for Mobile to stop responding for a given period. The parameters that help emulate link faults appear when you click the **Link Faults** tab.

Link Faults

☒ **Bit Error**

- Average error frequency: Once every bits (100-1000000000000)
- Number of toggled bits: Minimum bits (1-500), Maximum bits (1-500, Minimum < Maximum)

☒ **Disconnect**

- Average disconnection frequency: Once every sec (3-300)
- Disconnection time span: Minimum ms (10-30000), Maximum ms (10-30000, Minimum < Maximum)

☒ **Congestion**

- Average congestion frequency: Once every sec (1-300)
- Congestion time span: Minimum ms (10-65535), Maximum ms (10-65535, Minimum < Maximum)
- Congestion event properties:
 - Fixed Latency ms (0-8000)
 - Lose % of all packets (0-90)

You can emulate any of the link errors or all of them. Check the box of the fault type you want to emulate and then enter the parameters described below:

- ◆ **Bit Error:** In the Average Frequency box, type a number of bits (from 10^2 to 10^{12}). Bit toggling will occur every time that the indicated number of bits (on average) has crossed the WAN.

In the Minimum and Maximum parameters (Number of toggled bits), enter a range of numbers from 1 to 500. The vCat for Mobile randomly picks a number in the range and toggles as many bits

- ◆ **Disconnect:** The parameters in this group allow you to emulate a physical disconnection of the network. In the Average frequency box type the desired number of seconds (from 3 to 300). The vCat for Mobile will emulate a disconnection once every so many seconds on average. In the Minimum and Maximum boxes (Disconnection time span), indicate a time range in milliseconds (from 10 to 30,000 ms). The vCat for Mobile will randomly pick a time value from this range and the lines will remain "disconnected" during this time, by dropping all packets that go through the WAN during this period.
- ◆ **Congestion:** The Congestion feature helps you emulate a periodic and momentary rise in WAN traffic, which results in increased latency and packet loss.

Note: The Latency and Packet Loss values during the congestion event override the original values (either manually defined or imported).

Congestion Parameter	Description
Average congestion frequency	Type the frequency in seconds (from 1 to 300). For example, entering 20 means that the vCat for Mobile will increase latency and packet loss every 20 seconds on average.
Congestion time span	The duration of the event in milliseconds (from 10 to 65,535). Type a range in the Maximum and Minimum parameters. The vCat for Mobile randomly picks a value from this range and sets the latency and packet loss to the values you indicate in the Fixed Latency and Loss fields (below), for the selected duration. After this time, latency and packet loss return to their original settings (as described under the Latency and Packet Loss branches).
Congestion event properties	
Fixed Latency	Enter the latency, in milliseconds, that will prevail during the congestion time (from 0 to 8000 ms). This value replaces the original latency setting.
Lose x% of all packets	Enter a percentage of packets to be lost during the congestion time (from 0% to 90%). This value replaces the original setting for packet loss.

5

vCat for Mobile Web Service API

Shunra's API is included with the vCat for Mobile installation. It uses Representation State Transfer (REST). The Web Services API contains the following services:

- ◆ **Emulation Services** (5-1)
- ◆ **Configuration Services** (5-36)
- ◆ **Transaction Manager** (5-44)
- ◆ **License Manager** (5-49)

Note: To run the vCat for Mobile API on 64bit machine, use a 32bit-JRE. Certain headers are suggested examples only.

Emulation Services

The following API functions are described:

- ◆ **Start New Emulation**
- ◆ **Workaround to work with XML format**
- ◆ **Start New Emulation – Advance Mode**
- ◆ **Real Time Update**
- ◆ **Real Time Update for Advance Mode**
- ◆ **Stop Emulation**
- ◆ **Force Stop Emulation**
- ◆ **Get Emulation Tokens**
- ◆ **Get Emulation Parameters**
- ◆ **Get Statistics**
- ◆ **Start PacketList Capture – Specific and Global**

- ◆ **Stop Packet List Capture – Specific and Global**
- ◆ **Is PL Capturing**
- ◆ **Get Packet List IDs**
- ◆ **Download Packet List**
- ◆ **Download External Events File**
- ◆ **Traffic Resource Files**

Start New Emulation

This method starts a new emulation. It expects to receive an emulation request which includes an .ntxx file of network conditions to be played. It responds with the URL to the newly allocated emulation resource, which allows updates or stopping the emulation once started. It also returns a “token” in the HTTP body which is used in other types of requests, such as statistics or packet lists request as described in **Get Packet List IDs**.

Request

The body of the HTTP request holds the .ntxx file for the emulation device that is encoded in JSON format.

URL	http://ip:port/shunra/api/emulation
HTTP Method	POST
HTTP Headers	Content-Type: application/json Accept: application/json

HTTP Body

```
{ "ntx": "\u003cNETWORK_X ID\u003d\"AEA663095-021C-4883-B8D7-195A1F0066A9A\" NAME\u003d\"VE Desktop Professional Sample\" ORIGIN\u003d\"VE Desktop\" USER_DATA\u003d\"\" CREATED_BY\u003d\"VE Desktop\" DESCRIPTION\u003d\"NetworX_Document\" CREATED_ON_DATE\u003d\"2008-02-21 10:18:58\" NETWORK_X_VERSION\u003d\"2.0\" CREATED_ON_HOST_NAME\u003d\"shunra\" \u003e\r\n\t\t\u003cNET_OBJECTS\u003e\r\n\t\t\t\u003cENDPOINT
```

EXHIBIT A--193

```

NET_OBJECTS\u003e\r\n\t\t\r\n\t\t\t\u003cLINKS\u003e\r\n\t\t\t\t\t\u003cLINK TO_OBJECT\u003d\"ID_WAN_CLOUD\"
FROM_OBJECT\u003d\"ID_CLIENT_GW_NIC_1\"
UNIDIRECTIONAL\u003d\"false\"/>\u003e\r\n\t\t\t\t\t\u003cLINK
TO_OBJECT\u003d\"ID_SERVER_GW_NIC_2\"
FROM_OBJECT\u003d\"ID_WAN_CLOUD\"
UNIDIRECTIONAL\u003d\"false\"/>\u003e\r\n\t\t\t\t\t\u003cLINK
TO_OBJECT\u003d\"ID_SERVER\"
FROM_OBJECT\u003d\"ID_SERVER_GW_NIC_1\"
UNIDIRECTIONAL\u003d\"false\"/>\u003e\r\n\t\t\t\t\t\u003cLINK
TO_OBJECT\u003d\"ID_PACKET_LIST_CLIENT\"
FROM_OBJECT\u003d\"ID_CLIENT\"
UNIDIRECTIONAL\u003d\"false\"/>\u003e\u003cLINK
TO_OBJECT\u003d\"ID_CLIENT_GW_NIC_2\"
FROM_OBJECT\u003d\"ID_PACKET_LIST_CLIENT\"
UNIDIRECTIONAL\u003d\"false\"/>\u003e\u003c/
LINKS\u003e\r\n\t\t\t\t\t\u003cNETWORK_X\u003e\"}

```

Response

When an emulation starts successfully, the status code of 201 is received. A location header is returned and can be used for further manipulations on this emulation, such as stopping it or updating it.

The body holds an identifier which is unique to each user and emulation. This key identifies newly created emulations and allows manipulations such as receiving statistics or getting packet lists in the future, and is unique to each user and emulation.

HTTP Response Code	201 - Created
HTTP Headers	Content-Type: application/json; charset=UTF-8: http://172.30.2.23:8182/shunra/emulation/45ab93a6-7078-4df2-99e2-b28837987705c792b895-3ce7-4c6a-a644-ea6562323b23
HTTP Body	{\"identifier\":\"45ab93a6-7078-4df2-99e2-b28837987705c792b895-3ce7-4c6a-a644-ea6562323b23\"}

Workaround to work with XML format

Although built-in XML requests are not supported, the following workaround can be used to bypass using the JSON format. This is an example of a start emulation request, but it can be applied to RTU and validation requests as they both have the same HTTP Body content.

Request

Note: The original NTX can be copied and pasted as is into XML format.

URL	http://ip:port/shunra/api/emulation
HTTP Method	POST
HTTP Headers	Content-Type: text/xml Accept: application/xml

Body

```
<?xml version="1.0" standalone="yes"?>

<emulationQuery>

    <ntx><![CDATA[

<NETWOR_X ID="AEA663095-021C-4883-B8D7-195A1F0066A9A"
NAME="VE Desktop Professional Sample" ORIGIN="VE Desktop"
USER_DATA="" CREATED_BY="VE Desktop"
DESCRIPTION="NetworX_Document" CREATED_ON_DATE="2008-02-
21 10:18:58" NETWOR_X_VERSION="2.0"
CREATED_ON_HOST_NAME="shunra">
        <NET_OBJECTS>
            <ENDPOINT ID="ID_SERVER"
NAME="Server">
                <INCLUDE_IPS>
                    <IP_RANGE
PORT="0" TO_IP="254.254.254.254" FROM_IP="1.0.0.0"
PROTOCOL="0" IP_VERSION="4"/>
                </INCLUDE_IPS>
                <EXCLUDE_IPS>
```



```

                                <IP_RANGE
PORT="0" TO_IP="172.30.2.23" FROM_IP="172.30.2.23"
PROTOCOL="0" IP_VERSION="4"/>
                                </EXCLUDE_IPS>
                                </ENDPOINT>
                                <ENDPOINT ID="ID_CLIENT"
NAME="Client">
                                <INCLUDE_IPS>
                                <IP_RANGE
PORT="0" TO_IP="172.30.2.23" FROM_IP="172.30.2.23"
PROTOCOL="0" IP_VERSION="4"/>
                                </INCLUDE_IPS>
                                </ENDPOINT>
                                <GATEWAY ID="ID_SERVER_GW"
NAME="Server Gateway">
                                <NICS>
                                <NIC
ID="ID_SERVER_GW_NIC_1" NAME="Server Downlink"
BANDWIDTH="0" IN_BW_UTIL="0" OUT_BW_UTIL="0"
PACKET_OVERHEAD_BYTES=""/>
                                <NIC
ID="ID_SERVER_GW_NIC_2" NAME="Server Uplink"
BANDWIDTH="0" IN_BW_UTIL="0" OUT_BW_UTIL="0"
PACKET_OVERHEAD_BYTES=""/>
                                </NICS>
                                </GATEWAY>
                                <GATEWAY ID="ID_CLIENT_GW"
NAME="Client Gateway">
                                <NICS>
                                <NIC
ID="ID_CLIENT_GW_NIC_1" NAME="Client Uplink"
BANDWIDTH="56.0" IN_BW_UTIL="0" OUT_BW_UTIL="0"
PACKET_OVERHEAD_BYTES=""/>
                                <NIC ID="ID_CLIENT_GW_NIC_2" NAME="Client Downlink"
BANDWIDTH="56.0" IN_BW_UTIL="0" OUT_BW_UTIL="0"
PACKET_OVERHEAD_BYTES=""/>
                                </NICS>
                                </GATEWAY>
                                <WAN_CLOUD ID="ID_WAN_CLOUD"
NAME="WAN">
                                <FIXED_LATENCY
LATENCY="500"/>
                                </WAN_CLOUD>

```

```

        <PACKET_LIST
ID="ID_PACKET_LIST" NAME="Packet List client"/>
    </NET_OBJECTS>
    <LINKS>
        <LINK TO_OBJECT="ID_WAN_CLOUD"
FROM_OBJECT="ID_CLIENT_GW_NIC_1" UNIDIRECTIONAL="false"/>
        <LINK
TO_OBJECT="ID_SERVER_GW_NIC_2" FROM_OBJECT="ID_WAN_CLOUD"
UNIDIRECTIONAL="false"/>
        <LINK TO_OBJECT="ID_SERVER"
FROM_OBJECT="ID_SERVER_GW_NIC_1" UNIDIRECTIONAL="false"/>
        <LINK
TO_OBJECT="ID_PACKET_LIST" FROM_OBJECT="ID_CLIENT"
UNIDIRECTIONAL="false"/>
        <LINK
TO_OBJECT="ID_CLIENT_GW_NIC_2"
FROM_OBJECT="ID_PACKET_LIST" UNIDIRECTIONAL="false"/>
    </LINKS>
</NETWORK_X>
]]></ntx>
</emulationQuery>

```

Response

HTTP Response Code	201 - Created
HTTP Headers	Content-Type: application/xml; charset=UTF-8 Location: http://172.30.2.23:8182/shunra/emulation/5ebacbe9-0d49-4c5e-a65d-fd6a66e216c9948e8cfe
HTTP Body	xml version="1.0" encoding="UTF-8" standalone="yes"?><emulationResponse><identifier>5ebacbe9-0d49-4c5e-a65d-fd6a66e216c9948e8cfe-988e-448a-ae70-64f175af14b7</identifier></emulationResponse>

Start New Emulation – Advance Mode

This method starts the emulation in "Advanced mode" which requires latency, bandwidth, packet loss parameters and whether the packet capture of the client's packet list is required to build a valid .ntxx file and play it. All parameters

are optional and defaults will be used if a parameter is not provided. Creation of the .ntxx file takes the vCat Server configuration into account, for example modes such as Router mode.

Parameter Values:

- ◆ Bandwidth: 2.4-100000.0 Mbps
- ◆ Latency: 8000 milliseconds
- ◆ Packet Loss: 0.0-90.0 %

Request

URL	http://ip:port/shunra/api/emulation/advanced
HTTP Method	POST
HTTP Headers	Content-Type: application/json Accept: application/json
HTTP Body	{"latency":500,"packetloss":20.0,"bandwidth":2048.0,"isCaptureClientPL":"true"}

Response

HTTP Response Code	201 - Created
HTTP Headers	Content-Type: application/json; charset=UTF-8 Location: http://ip:port/shunra/emulation/advanced
HTTP Body	{"identifier":"92d8ebb2-012d-4fef-94ac-b8c0e3288918f8572958-833a-4cb7-84d9-97ad5ff7aa67"}

Real Time Update

This method performs real time updates on emulations that are already playing. Only existing parameters can be changed, and additional shapes cannot be added. This method must have the identifier given by start emulation, or

use the same URL that was returned in the location header of the start emulation request.

Note: If the "Start New Emulation" method was used, then use the "Real Time Update" method. If "Start New Emulation – Advanced Mode" was used, the "Advance Real Time Update" method should be used.

Request

Contains the HTTP body, just like in the start emulation request; it contains the .ntxx in JSON format.

URL	http://ip:port/shunra/api/emulation/45ab93a6-7078-4df2-99e2-b28837987705c792b895-3ce7-4c6a-a644-ea6562323b23
HTTP Method	PUT
HTTP Headers	Content-Type: application/json Accept: application/json

HTTP Body

[illegible]

[illegible]

```

TO_OBJECT\u003d\"ID_PACKET_LIST\"
FROM_OBJECT\u003d\"ID_CLIENT\"
UNIDIRECTIONAL\u003d\"false\"/\u003e\u003cLINK
TO_OBJECT\u003d\"ID_CLIENT_GW_NIC_2\"
FROM_OBJECT\u003d\"ID_PACKET_LIST\"
UNIDIRECTIONAL\u003d\"false\"/\u003e\u003c/
LINKS\u003e\r\n\t\u003c/NETWOR_X\u003e\"}

```

Response

HTTP Response Code	204 - NO CONTENT
HTTP Headers	Content-Type: application/json; charset=UTF-8
HTTP Body	None

Real Time Update for Advance Mode

Real time update for emulations that are already running. Note that this method is the complement of the Start Advance Emulation. Using this method for an emulation that was started with a standard .ntxx file most likely will not work.

As in a standard Real Time Update adding shapes is not allowed, therefore the packet list parameter is not present.

Request

URL	http://ip:port/shunra/api/emulation/advanced/a279004d-b4aa-4854-ae41-83ac302b495e559f6d46-2677-48ee-b770-8cd2c59a28c9
HTTP Method	PUT
HTTP Headers	Content-Type: application/json

5-12

*vCat for Mobile Manual***Chapter 5**

Body	{"latency":50,"packetloss":20.0,"bandwidth":2048.0}
------	---

Response

HTTP Response Code	204 - No Content
HTTP Headers	
HTTP Body	

Get Emulation Parameters

This method is valid only when an emulation is currently running. It returns data which includes shape IDs, endpoints, .ntxx names, etc.

Request

URL	http://ip:port/shunra/api/emulation/parameters
HTTP Method	GET
HTTP Headers	Accept: application/json
HTTP Body	None

Response

The response includes HTTP body in JSON format which holds the requested info.

HTTP Response Code	200 - OK
HTTP Headers	Content-Type: application/json; charset=UTF-8

HTTP Body

```
{
  "emulationParameters": {
    "7d376e7b-895a-49cc-9989-f36577f6875d91b2d56e-d937-444c-b886-9e74b84d4c54": {
      "shapesIdentificationCollection": [(10)
        {
          "shapeId": "ID_SERVER",
          "shapeType": "ENDPOINT",
          "shapeName": "Server"
        },
        {
          "shapeId": "ID_CLIENT",
          "shapeType": "ENDPOINT",
          "shapeName": "Client"
        },
        {
          "shapeId": "ID_SERVER_GW",
          "shapeType": "GATEWAY",
          "shapeName": "Server Gateway"
        },
        {
          "shapeId": "ID_SERVER_GW_NIC_1",
          "shapeType": "NIC",
          "shapeName": "Server Downlink"
        },
        {
          "shapeId": "ID_SERVER_GW_NIC_2",
```



```

        "shapeType": "NIC",
        "shapeName": "Server Uplink"
    },
    {
        "shapeId": "ID_CLIENT_GW",
        "shapeType": "GATEWAY",
        "shapeName": "Client Gateway"
    },
    {
        "shapeId": "ID_CLIENT_GW_NIC_1",
        "shapeType": "NIC",
        "shapeName": "Clent Uplink"
    },
    {
        "shapeId": "ID_CLIENT_GW_NIC_2",
        "shapeType": "NIC",
        "shapeName": "Clent Downlink"
    },
    {
        "shapeId": "ID_WAN_CLOUD",
        "shapeType": "WAN_CLOUD",
        "shapeName": "WAN"
    },
    {
        "shapeId": "ID_PACKET_LIST",
        "shapeType": "PACKET_LIST",
        "shapeName": "Packet List client"
    }
],
"endpointsCollection": [(2)
{
    "endpointId": "ID_SERVER",
    "endpointName": "Server",
    "includeIpRanges": [(1)
    {
        "from": "1.0.0.0",
        "to": "254.254.254.254"
    }
    ],
    "excludeIpRanges": [(1)
    {
        "from": "172.30.2.23",
        "to": "172.30.2.23"
    }
    ]
}

```

```

    ]
  },
  {
    "endpointId": "ID_CLIENT",
    "endpointName": "Client",
    "includeIpRanges": [{1}
      {
        "from": "172.30.2.23",
        "to": "172.30.2.23"
      }
    ],
    "excludeIpRanges": [{0}]
  }
],
  "emulationName": "VE Desktop Professional Sample" ,
  "executingNtx": "<NETWOR_X CREATED_BY=\\"vCat Client\\"
  CREATED_ON_DATE=\\"2008-03-03 15:55:46\\"
  CREATED_ON_HOST_NAME=\\"shunra\\" ID=\\"NetworX_ID\\"
  NAME=\\"Default Network Template\\"
  NETWOR_X_VERSION=\\"1.8\\"
  ORIGIN=\\"VedC\\">\r\n\t<NET_OBJECTS>\r\n\t\t<ENDPOINT
  ID=\\"ID_SERVER_FLOWS_1\\"
  NAME=\\"Server\\">\r\n\t\t<INCLUDE_IPS>\r\n\t\t<IP_RANGE
  FROM_IP=\\"1.0.0.0\\" IP_VERSION=\\"4\\" PORT=\\"0\\"
  PROTOCOL=\\"0\\" TO_IP=\\"254.254.254.254\\"/>\r\n\t</
  INCLUDE_IPS>\r\n\t\t<EXCLUDE_IPS>\r\n\t\t<IP_RANGE
  FROM_IP=\\"172.30.2.18\\" IP_VERSION=\\"4\\" PORT=\\"0\\"
  PROTOCOL=\\"0\\" TO_IP=\\"172.30.2.18\\"/>\r\n\t\t</
  EXCLUDE_IPS>\r\n\t\t</ENDPOINT>\r\n\t\t\t<ENDPOINT
  ID=\\"ID_CLIENT_FLOWS_1\\"
  NAME=\\"Client\\">\r\n\t\t\t<INCLUDE_IPS>\r\n\t\t\t<IP_RANGE
  FROM_IP=\\"172.30.2.18\\" IP_VERSION=\\"4\\" PORT=\\"0\\"
  PROTOCOL=\\"0\\" TO_IP=\\"172.30.2.18\\"/>\r\n\t\t\t<IP_RANGE
  FROM_IP=\\"0.0.0.0\\" IP_VERSION=\\"4\\" PORT=\\"0\\"
  PROTOCOL=\\"0\\" TO_IP=\\"0.0.0.0\\"/>\r\n\t\t\t</
  INCLUDE_IPS>\r\n\t\t\t</ENDPOINT>\r\n\t\t\t\t<GATEWAY
  ID=\\"ID_SERVER_GW_FLOWS_1\\" NAME=\\"Server
  Gateway\\">\r\n\t\t\t\t\t<NICS>\r\n\t\t\t\t\t\t<NIC
  BANDWIDTH=\\"0\\" ID=\\"ID_SERVER_GW_NIC_1_FLOWS_1\\"
  IN_BW_UTIL=\\"0\\" NAME=\\"Server Downlink\\"
  OUT_BW_UTIL=\\"0\\" PACKET_OVERHEAD_BYTES=\\""/
  >\r\n\t\t\t\t\t\t\t<NIC BANDWIDTH=\\"0\\"
  ID=\\"ID_SERVER_GW_NIC_2_FLOWS_1\\" IN_BW_UTIL=\\"0\\"
  NAME=\\"Server Uplink\\" OUT_BW_UTIL=\\"0\\"

```

```

PACKET_OVERHEAD_BYTES="\\"/>\r\n\t\t\t</NICS>\r\n\t\t\t</
GATEWAY>\r\n\t\t\t<GATEWAY ID="\ID_CLIENT_GW_FLOWS_1\"
NAME="\Client Gateway\">\r\n\t\t\t<NICS>\r\n\t\t\t\t\t<NIC
BANDWIDTH="\2048\" ID="\ID_CLIENT_GW_NIC_1_FLOWS_1\"
IN_BANDWIDTH="\\" IN_BW_UTIL="\0\"
IN_BW_UTIL_SLOT_SIZE="\\" NAME="\Clent Uplink\"
OUT_BANDWIDTH="\\" OUT_BW_UTIL="\0\"
OUT_BW_UTIL_SLOT_SIZE="\\" PACKET_OVERHEAD_BYTES="\\"
PREPARE_RTU_ON_INIT="\no\" START_TIME_BW_PLAYBACK="\\"/
>\r\n\t\t\t\t\t<NIC BANDWIDTH="\2048\"
ID="\ID_CLIENT_GW_NIC_2_FLOWS_1\" IN_BANDWIDTH="\\"
IN_BW_UTIL="\0\" IN_BW_UTIL_SLOT_SIZE="\\" NAME="\Clent
Downlink\" OUT_BANDWIDTH="\\" OUT_BW_UTIL="\0\"
OUT_BW_UTIL_SLOT_SIZE="\\" PACKET_OVERHEAD_BYTES="\\"
PREPARE_RTU_ON_INIT="\no\" START_TIME_BW_PLAYBACK="\\"/
>\r\n\t\t\t\t\t</NICS>\r\n\t\t\t</GATEWAY>\r\n\t\t\t<WAN_CLOUD
ID="\ID_WAN_CLOUD_FLOWS_1\"
NAME="\WAN\">\r\n\t\t\t<FIXED_LATENCY LATENCY="\500\"/
>\r\n\t\t\t<RANDOM_LOSS CHANCE="\20\"/>\r\n\t\t\t</
WAN_CLOUD>\r\n\t\t\t<PACKET_LIST ID="\ID_CLIENT_PL_FLOWS_1\"
NAME="\Packet List Client\"/>\r\n\t\t\t</
NET_OBJECTS>\r\n\t\t\t<LINKS>\r\n\t\t\t\t\t<LINK
FROM_OBJECT="\ID_CLIENT_PL_FLOWS_1\"
TO_OBJECT="\ID_CLIENT_GW_NIC_2_FLOWS_1\"
UNIDIRECTIONAL="\false\"/>\r\n\t\t\t\t\t<LINK
FROM_OBJECT="\ID_CLIENT_GW_NIC_1_FLOWS_1\"
TO_OBJECT="\ID_WAN_CLOUD_FLOWS_1\"
UNIDIRECTIONAL="\false\"/>\r\n\t\t\t\t\t<LINK
FROM_OBJECT="\ID_WAN_CLOUD_FLOWS_1\"
TO_OBJECT="\ID_SERVER_GW_NIC_2_FLOWS_1\"
UNIDIRECTIONAL="\false\"/>\r\n\t\t\t\t\t<LINK
FROM_OBJECT="\ID_SERVER_GW_NIC_1_FLOWS_1\"
TO_OBJECT="\ID_SERVER_FLOWS_1\" UNIDIRECTIONAL="\false\"/
>\r\n\t\t\t\t\t<LINK FROM_OBJECT="\ID_CLIENT_FLOWS_1\"
TO_OBJECT="\ID_CLIENT_PL_FLOWS_1\"
UNIDIRECTIONAL="\false\"/>\r\n\t\t\t</LINKS>\r\n\t\t\t</NETWOR_X>\r\"

    }

}

}

```

Stop Emulation

This method stops a specific emulation.

Note: A two second timeout must be applied between the time a transaction stops (all traffic has ended) and before this command is used, otherwise not all of the transaction data will be included in the packet list.

Request

URL	http://ip:port/shunra/api/emulation/45ab93a6-7078-4df2-99e2-b28837987705c792b895-3ce7-4c6a-a644-ea6562323b23
HTTP Method	DELETE
HTTP Headers	Accept: application/json
Body	None

Response

HTTP Response Code	200- Ok
HTTP Body	{"analysisResourcesLocation":"C:\\ProgramData\\Shunra\\vCat\\13da6e01-8e78-4428-92f2-6028ee172c4c\\e5ea7e1b-7946-43fc-9e26-556f814b3220\\AnalysisResources.shunra"}

Force Stop Emulation

This method stops all currently executing emulations and resets the driver without any parameters (use with caution). No special headers are required.

5-18

*vCat for Mobile Manual***Chapter 5****Request**

URL	http://ip:port/shunra/api/emulation
HTTP Method	DELETE
Body	None

Response

HTTP Response Code	204- No Content
HTTP Body	None

Get Emulation Tokens

This method returns all available identifiers of emulations. For vCat it should be an array of single element. If no emulation is running, a No Content response is expected.

Request

URL	http://ip:port/shunra/api/emulation/tokens
HTTP Method	GET
HTTP Headers	Accept: application/json
Body	

Response

Http Response Code	204 - No Content in case no emulation is running 200 – OK
HTTP Headers	
HTTP Body	{"tokens":["5b3e7d9f-6016-4810-9dbf-89cfadca363b7cc4efa7-e1eb-4a0a-b6fb-c5572a723da9"]}

Get Statistics

This method retrieves statistics for an emulation that ran, or is currently running. Statistics are cached for about 15 minutes, therefore statistics from the previous run can be retrieved, but only if another emulation didn't override the results.

Data can be retrieved up to the last point in the previous query; data from after that point is appended in a value to the URI. This is an "anchor" and it can be obtained from returned headers. This is a Shunra proprietary header: X-Shunra-Next.

Both types of requests may or may not include a HTTP body. When no body is sent, all the shape's statistics are returned. When the body is sent, only statistics matching the shape's IDs in the body are returned.

Note: Since one of the 2 Gateway NICs is always ignored, the ignored shapes do not appear in the statistics response

Note: A two second timeout must be applied between the time a transaction stops (all traffic has ended) and before this command is used, otherwise not all of the transaction statistics will be included.

First Request – Specific shapes

URL	http://ip:port/shunra/api/statistics/cb9e09c7-c7ca-459a-9253-8ee2c01e8886c8b6a761-8ab2-494c-9a48-02c1e19f2715
-----	---

5-20

*vCat for Mobile Manual***Chapter 5**

HTTP Method	PUT
HTTP Headers	Content-Type: application/json Accept: application/json
Body	{"shapeIds":["ID_CLIENT_GW_NIC_1","ID_SERVER_GW_NIC_2"]}

Second and additional Requests - Specific shapes

URL	http://ip:port/ shunra/api/statistics/cb9e09c7-c7ca-459a-9253-8ee2c01e8886c8b6a761-8ab2-494c-9a48-02c1e19f2715/1336025450197
HTTP Method	PUT
HTTP Headers	Content-Type: application/json Accept: application/json
Body	{"shapeIds":["ID_CLIENT_GW_NIC_1","ID_SERVER_GW_NIC_2"]}

First Request for all Shapes

URL	http://ip:port/ shunra/api/statistics/cb9e09c7-c7ca-459a-9253-8ee2c01e8886c8b6a761-8ab2-494c-9a48-02c1e19f2715
HTTP Method	PUT
HTTP Headers	Accept: application/json
HTTP Body	

Response

HTTP Response Code	200- OK
HTTP Headers	Content-Type: application/json; charset=UTF-8 X-Shunra-Next: 1336025450197

HTTP Body

```
{
  "statistics": [{
    "timeStamp": 1336025449191,
    "shapeStatisticsList": [{
      "shapeId": "ID_CLIENT_PL_FLOWS_1",
      "shapeType": "PACKET_LIST",
      "statisticsCollection": [{
        "Attribute": "CURR_MEM",
        "Value": "17203"
      }, {
        "Attribute": "ENABLED",
        "Value": "YES"
      }, {
        "Attribute": "SHAPE_REF_ID",
        "Value": ""
      }, {
        "Attribute": "TOTAL_MEM",
        "Value": "104857600"
      }
    ]
  }, {
    "shapeId": "ID_WAN_CLOUD",
    "shapeType": "WAN_CLOUD",
    "statisticsCollection": [{
      "Attribute": "AVG_LATENCY",
      "Value": "499.75000"
    }, {
      "Attribute": "BIT_ERROR_COUNT",
      "Value": "0"
    }, {
      "Attribute": "CURR_PACKETS",
      "Value": "0"
    }, {
      "Attribute": "DUPLICATED_COUNT",
      "Value": "0"
    }
  }, {
```



```

        "Attribute": "FRAGMENTED_COUNT",
        "Value": "0"
    }, {
        "Attribute": "LINK_DISCONNECT_COUNT",
        "Value": "0"
    }, {
        "Attribute": "MAX_LATENCY",
        "Value": "501.00000"
    }, {
        "Attribute": "MAX_PACKETS",
        "Value": "0"
    }, {
        "Attribute": "MIN_LATENCY",
        "Value": "499.00000"
    }, {
        "Attribute": "OUT_OF_ORDER_COUNT",
        "Value": "0"
    }, {
        "Attribute": "PACKETS_LOSS_COUNT",
        "Value": "0"
    }, {
        "Attribute": "PACKETS_LOSS_TOTAL",
        "Value": "0"
    }, {
        "Attribute": "PACKET_LOSS_PERCENT",
        "Value": "0.0000"
    }
  ]
}, {
  "shapeId": "ID_CLIENT_GW_NIC_1",
  "shapeType": "NIC",
  "statisticsCollection": [{
    "Attribute": "AVG_LATENCY_IN",
    "Value": "0.0"
  }, {
    "Attribute": "AVG_LATENCY_OUT",
    "Value": "0.0"
  }, {
    "Attribute": "BPS_IN",
    "Value": "2400.00"
  }, {
    "Attribute": "BPS_OUT",
    "Value": "35240.00"
  }, {
    "Attribute": "BW_UTIL_IN",
    "Value": "4.2857"
  }, {
    "Attribute": "BW_UTIL_OUT",
    "Value": "62.9286"
  }
]

```

```

    }, {
      "Attribute": "MAX_LATENCY_IN",
      "Value": "0.0"
    }, {
      "Attribute": "MAX_LATENCY_OUT",
      "Value": "0.0"
    }, {
      "Attribute": "MIN_LATENCY_IN",
      "Value": "0.0"
    }, {
      "Attribute": "MIN_LATENCY_OUT",
      "Value": "0.0"
    }, {
      "Attribute": "Q_LEN_IN",
      "Value": "0"
    }, {
      "Attribute": "Q_LEN_OUT",
      "Value": "0"
    }, {
      "Attribute": "Q_LOSS_COUNT_IN",
      "Value": "0"
    }, {
      "Attribute": "Q_LOSS_COUNT_OUT",
      "Value": "0"
    }, {
      "Attribute": "TOTAL_IN",
      "Value": "4801.00"
    }, {
      "Attribute": "TOTAL_OUT",
      "Value": "14223.00"
    }
  ]
}, {
  "shapeId": "ID_SERVER_GW_NIC_2",
  "shapeType": "NIC",
  "statisticsCollection": [{
    "Attribute": "AVG_LATENCY_IN",
    "Value": "0.0"
  }, {
    "Attribute": "AVG_LATENCY_OUT",
    "Value": "0.0"
  }, {
    "Attribute": "BPS_IN",
    "Value": "35240.00"
  }, {
    "Attribute": "BPS_OUT",
    "Value": "2400.00"
  }, {
    "Attribute": "BW_UTIL_IN",

```

```

        "Value": "0.0000"
      }, {
        "Attribute": "BW_UTIL_OUT",
        "Value": "0.0000"
      }, {
        "Attribute": "MAX_LATENCY_IN",
        "Value": "0.0"
      }, {
        "Attribute": "MAX_LATENCY_OUT",
        "Value": "0.0"
      }, {
        "Attribute": "MIN_LATENCY_IN",
        "Value": "0.0"
      }, {
        "Attribute": "MIN_LATENCY_OUT",
        "Value": "0.0"
      }, {
        "Attribute": "Q_LEN_IN",
        "Value": "0"
      }, {
        "Attribute": "Q_LEN_OUT",
        "Value": "0"
      }, {
        "Attribute": "Q_LOSS_COUNT_IN",
        "Value": "0"
      }, {
        "Attribute": "Q_LOSS_COUNT_OUT",
        "Value": "0"
      }, {
        "Attribute": "TOTAL_IN",
        "Value": "14223.00"
      }, {
        "Attribute": "TOTAL_OUT",
        "Value": "4801.00"
      }
    ]
  }, {
    "timeStamp": 1336025450197,
    "shapeStatisticsList": [{
      "shapeId": "ID_CLIENT_PL_FLOWS_1",
      "shapeType": "PACKET_LIST",
      "statisticsCollection": [{
        "Attribute": "CURR_MEM",
        "Value": "17203"
      }, {
        "Attribute": "ENABLED",
        "Value": "YES"
      }
    ], {
    }
  }, {

```

```

        "Attribute": "SHAPE_REF_ID",
        "Value": ""
    }, {
        "Attribute": "TOTAL_MEM",
        "Value": "104857600"
    }
  ], {
    "shapeId": "ID_WAN_CLOUD",
    "shapeType": "WAN_CLOUD",
    "statisticsCollection": [{
      "Attribute": "AVG_LATENCY",
      "Value": "499.75000"
    }, {
      "Attribute": "BIT_ERROR_COUNT",
      "Value": "0"
    }, {
      "Attribute": "CURR_PACKETS",
      "Value": "0"
    }, {
      "Attribute": "DUPLICATED_COUNT",
      "Value": "0"
    }, {
      "Attribute": "FRAGMENTED_COUNT",
      "Value": "0"
    }, {
      "Attribute": "LINK_DISCONNECT_COUNT",
      "Value": "0"
    }, {
      "Attribute": "MAX_LATENCY",
      "Value": "501.00000"
    }, {
      "Attribute": "MAX_PACKETS",
      "Value": "0"
    }, {
      "Attribute": "MIN_LATENCY",
      "Value": "499.00000"
    }, {
      "Attribute": "OUT_OF_ORDER_COUNT",
      "Value": "0"
    }, {
      "Attribute": "PACKETS_LOSS_COUNT",
      "Value": "0"
    }, {
      "Attribute": "PACKETS_LOSS_TOTAL",
      "Value": "0"
    }, {
      "Attribute": "PACKET_LOSS_PERCENT",
      "Value": "0.0000"
    }
  ]
}

```

```

    }, {
      "shapeId": "ID_CLIENT_GW_NIC_1",
      "shapeType": "NIC",
      "statisticsCollection": [{
        "Attribute": "AVG_LATENCY_IN",
        "Value": "0.0"
      }, {
        "Attribute": "AVG_LATENCY_OUT",
        "Value": "0.0"
      }, {
        "Attribute": "BPS_IN",
        "Value": "2400.00"
      }, {
        "Attribute": "BPS_OUT",
        "Value": "35240.00"
      }, {
        "Attribute": "BW_UTIL_IN",
        "Value": "4.2857"
      }, {
        "Attribute": "BW_UTIL_OUT",
        "Value": "62.9286"
      }, {
        "Attribute": "MAX_LATENCY_IN",
        "Value": "0.0"
      }, {
        "Attribute": "MAX_LATENCY_OUT",
        "Value": "0.0"
      }, {
        "Attribute": "MIN_LATENCY_IN",
        "Value": "0.0"
      }, {
        "Attribute": "MIN_LATENCY_OUT",
        "Value": "0.0"
      }, {
        "Attribute": "Q_LEN_IN",
        "Value": "0"
      }, {
        "Attribute": "Q_LEN_OUT",
        "Value": "0"
      }, {
        "Attribute": "Q_LOSS_COUNT_IN",
        "Value": "0"
      }, {
        "Attribute": "Q_LOSS_COUNT_OUT",
        "Value": "0"
      }, {
        "Attribute": "TOTAL_IN",

```

```

        "Value": "4801.00"
      }, {
        "Attribute": "TOTAL_OUT",
        "Value": "14223.00"
      }
    ], {
      "shapeId": "ID_SERVER_GW_NIC_2",
      "shapeType": "NIC",
      "statisticsCollection": [{
        "Attribute": "AVG_LATENCY_IN",
        "Value": "0.0"
      }, {
        "Attribute": "AVG_LATENCY_OUT",
        "Value": "0.0"
      }, {
        "Attribute": "BPS_IN",
        "Value": "35240.00"
      }, {
        "Attribute": "BPS_OUT",
        "Value": "2400.00"
      }, {
        "Attribute": "BW_UTIL_IN",
        "Value": "0.0000"
      }, {
        "Attribute": "BW_UTIL_OUT",
        "Value": "0.0000"
      }, {
        "Attribute": "MAX_LATENCY_IN",
        "Value": "0.0"
      }, {
        "Attribute": "MAX_LATENCY_OUT",
        "Value": "0.0"
      }, {
        "Attribute": "MIN_LATENCY_IN",
        "Value": "0.0"
      }, {
        "Attribute": "MIN_LATENCY_OUT",
        "Value": "0.0"
      }, {
        "Attribute": "Q_LEN_IN",
        "Value": "0"
      }, {
        "Attribute": "Q_LEN_OUT",
        "Value": "0"
      }, {
        "Attribute": "Q_LOSS_COUNT_IN",
        "Value": "0"
      }
    ], {

```

```

        "Attribute": "Q_LOSS_COUNT_OUT",
        "Value": "0"
      }, {
        "Attribute": "TOTAL_IN",
        "Value": "14223.00"
      }, {
        "Attribute": "TOTAL_OUT",
        "Value": "4801.00"
      }
    ]
  }
}

```

Start PacketList Capture – Specific and Global

This method starts the capture of a specific or all packet lists in the .ntxx file online. It requires only the packet list ID, as it is relevant only when the emulation is active.

Note: If start capture follows the end of a capture without downloading the packet list online, then this capture phase is lost.

Request – Global

Starts capturing **all** packet lists in the currently playing the network conditions (.ntxx).

URL	http://ip:port/shunra/api/emulation/trafficresource/capture
HTTP Method	POST
HTTP Headers	
Body	

Request – Specific

Starts capturing specific packet lists in the currently playing .ntxx file.

URL	http://ip:port/shunra/emulation/trafficresource/capture/ ID_CLIENT_PL_FLOWS_1
HTTP Method	POST
HTTP Headers	
HTTP Body	

Response

Http Response Code	204- No Content
HTTP Headers	
HTTP Body	

Stop Packet List Capture – Specific and Global

This method stops the capture of a specific or all packet lists in the .ntxx file online.

Request – Global

Stop capture of **all** packet lists in the currently playing .ntxx file.

URL	http://ip:port/shunra/api/emulation/trafficresource/capture
HTTP Method	DELETE

5-30

*vCat for Mobile Manual***Chapter 5**

HTTP Headers	
Body	

Request – Specific

Stops the capture of specific packet lists in the .ntxx file currently playing.

URL	http://ip:port/shunra/api/emulation/trafficresource/capture/ ID_CLIENT_PL_FLOWS_1
HTTP Method	DELETE
HTTP Headers	
Body	

Response

Http Response Code	204 - No Content
HTTP Headers	
HTTP Body	

Is PL Capturing

This method is relevant only during emulation. It returns the status of the global packet list capture, or of a specific packet list. By default, if a packet list is present in the .ntxx file, then it will be captured.

Request - Global flag

URL	http://ip:port/shunra/api/emulation/trafficresource/capture
HTTP Method	GET
HTTP Headers	Accept: application/json
Body	

Response

HTTP Response Code	200-OK
HTTP Headers	
HTTP Body	{ "isCaptureEnabled": "true" }

Get Packet List IDs

This method returns the IDs of packet lists based on emulation tokens, so this method can be relevant for current runs or even for past runs. It returns the IDs as long as the packet lists are present on the local disk. If at some point the packet lists were cleared, then nothing will be returned.

Request - Specific PL

Adds the Packet List ID to the URL.

URL	http://ip:port/shunra/api/emulation/trafficresource/capture/ ID_CLIENT_PL_FLOWS_1
-----	--

HTTP Method	GET
HTTP Headers	Accept: application/json
HTTP Body	

Request

URL	http://ip:port/shunra/api/emulation/trafficresource/packetlistids/fad1be7f-679a-4615-9f54-5b52e1f8003ee3371bf0-580e-4554-b280-33e7cc934986
HTTP Method	GET
HTTP Headers	Accept: application/json
Body	

Response

HTTP Response Code	200- OK
HTTP Headers	
HTTP Body	{"packetListIds":["ID_CLIENT_PL_FLOWS_1","ID_SERVER_PL_FLOWS_1"]}

Download Packet List

Downloads the actual packet list to a location selected by the client. This command can be also executed via the browser, in offline or online mode. . It

always requires an emulation identifier and packet list ID. The result is a binary stream.

Note: A two second timeout must be applied between the time a transaction stops (all traffic has ended) and before this command is used, otherwise not all of the transaction data will be included in the packet list.

Request

URL	http://ip:port/shunra/api/emulation/trafficresource/packetlist/be0d97a2-4dc4-42cf-9694-ca76601e6ffacf15225d-fe2e-459f-8191-cb7f6cc57bca/ID_CLIENT_PL_FLOWS_1
HTTP Method	GET
HTTP Headers	Accept: application/octet-stream
Body	

Response

HTTP Response Code	200- OK
HTTP Headers	
HTTP Body	The requested binary file.

Download External Events File

Downloads the external events file for a specific execution, in offline or in online mode.

Note: A two second timeout should be applied between the time a transaction stops and before this command is applied.

Request

URL	http://ip:port/shunra/api/emulation/trafficresource/externalevents/ be0d97a2-4dc4-42cf-9694-ca76601e6ffacf15225d-fe2e-459f-8191-cb7f6cc57bca
HTTP Method	GET
HTTP Headers	Accept: application/xml
Body	

Response

Http Response Code	200 - OK
HTTP Headers	
HTTP Body	The requested file.

Traffic Resource Files

The .shunra file is a proprietary format of a file that includes data that can be analyzed. It is created automatically when the emulation is stopped. This file then can be downloaded offline via the web API.

This .shunra file can be also created and downloaded on demand for a specific single packet list online and offline.

Download .shunra file offline**Request**

URL	http://ip:port/shunra/api/emulation/trafficresource/analysisresources/ be0d97a2-4dc4-42cf-9694-ca76601e6ffacf15225d-fe2e-459f-8191-cb7f6cc57bca
HTTP Method	GET
HTTP Headers	Accept: application/zip
HTTP Body	

Download a .shunra file for a specific Packet List

Note: A two second timeout must be applied between the time a transaction stops (all traffic has ended) and before this command is used, otherwise not all of the transaction data will be included in the packet list.

Request

This method is available in online and offline modes.

URL	http://ip:port/shunra/api/emulation/trafficresource/analysisresources/ be0d97a2-4dc4-42cf-9694-ca76601e6ffacf15225d-fe2e-459f-8191-cb7f6cc57bca/ID_CLIENT_PL_FLOWS_1
HTTP Method	GET
HTTP Headers	Accept: application/zip
HTTP Body	

Response

The response includes a zipped .shunra results file.

HTTP Response Code	200-OK
HTTP Headers	
HTTP Body	A file in .zip format

Configuration Services

The following API functions are described:

- ◆ **Set Active Adapter**
- ◆ **Get Active Adapter**
- ◆ **Add Exclude IP/PORT Range**
- ◆ **Remove Exclude IP/PORT Range**
- ◆ **Get All Exclude IP/PORT Ranges**
- ◆ **Get Version Info**
- ◆ **Set Configuration**
- ◆ **Get Configuration**

Set Active Adapter

This API is a configuration API which influences all emulations. When more than one Adapter is present in the system, the active Adapter must be set. The active Adapter is the Adapter on which the emulation will be executed.

The IP value is checked against active Adapters available on the vCat for Mobile machine. If the Adapter is not valid, an error is returned.

When the active Adapter does not change it does not have to be reset.

Request

URL	http://ip:port/shunra/api/configuration/adapter/
HTTP Method	PUT
HTTP Headers	Content-Type: application/json
Body	{"ip":"172.30.4.5","reverseDirection":"true"}

Response

HTTP Response Code	204 - No Content
HTTP Headers	
HTTP Body	

Get Active Adapter

This method returns the active adapter that was set previously; if the user has not selected a value the default value in the system is used.

Request

URL	http://ip:port/shunra/api/configuration/adapter/
HTTP Method	GET
HTTP Headers	Accept: application/json

Body	
------	--

Response

HTTP Response Code	200 - OK
HTTP Headers	Content-Type: application/json
HTTP Body	{"ip":"172.30.4.5","reverseDirection":"true"}

Add Exclude IP/PORT Range

Adds the excluded range to the driver. This is a general configuration that affects all emulations.

The protocol is an integer number based on the following protocol list:

http://en.wikipedia.org/wiki/List_of_IP_protocol_numbers

- ◆ Port resolution is available only for TCP and UDP (6 & 17).
- ◆ If port is not given, the default is all ports
- ◆ If protocol is not given, the default is all protocols

Note: Port resolution is available only for TCP and UDP (6 and 17).

Request

URL	http://ip:port/shunra/api/configuration/exclude
HTTP Method	POST
HTTP Headers	Content-Type: application/json

Body	{"fromIp":"172.30.4.5","toIp":"198.168.4.5","port":5555,"protocol":17}
------	--

Response

Http Response Code	204- No Content
HTTP Headers	
HTTP Body	

Remove Exclude IP/PORT Range**Request – Specific Range**

URL	http://ip:port/shunra/api/configuration/exclude
HTTP Method	PUT
HTTP Headers	Content-Type: application/json
HTTP Body	{"fromIp":"172.30.4.5","toIp":"198.168.4.5","port":5555,"protocol":17}

Request – All Ranges

This request removes all ranges previously defined but not the default range which includes the active adapter, TCP protocol and vCat server port.

URL	http://ip:port/shunra/api/configuration/exclude
-----	---

5-40

*vCat for Mobile Manual***Chapter 5**

HTTP Method	DELETE
HTTP Headers	
Body	

Response

Http Response Code	204 - No Content
HTTP Headers	
HTTP Body	

Get All Exclude IP/PORT Ranges

Method designed to get all currently configured excluded ranges in the driver.

Request

URL	http://ip:port/shunra/api/configuration/exclude
HTTP Method	GET
HTTP Headers	Accept: application/json
Body	

Response

Http Response Code	200 - OK
HTTP Headers	
HTTP Body	<pre>{ "rangesCollection": [{ "fromIp": "172.30.2.1", "toIp": "172.30.2.1", "protocol": 6, "port": 8182 }] }</pre>

Get Version Info

Gets the version number of the product and the type of emulation engine.

Request

URL	http://ip:port/shunra/api/configuration/version
HTTP Method	GET
HTTP Headers	Accept: application/json
Body	

Response

HTTP Response Code	200- OK
--------------------	---------

HTTP Headers	
HTTP Body	<pre>{ "versionProperties":{ "JavaVersion":"1.6.0_21", "BuildNumber": "1.2.Not Real Deployment.Allowed only when running from SDK", "EmulationEngineType": "DRIVER", "MajorVersionNumber": "2.1.Not Real Deployment.Allowed only when running from SDK", "ProductDescription": "I am a DRIVER. I do not know why Someone wants me and what does this property means and from where I should be loaded", "productkey": "27" } }</pre>

Set Configuration

This method sets the vCat server's general configuration. The configuration can be executed only if an emulation is not currently running.

Note: The recommended size for "packetListMaxSizeMB" is 100MB.

Request

URL	http://ip:port/shunra/api/configuration
HTTP Method	PUT
HTTP Headers	Content-Type: application/json
Body	<pre>{ "isOverrideIP":"false", "isRouterModeOn":"true", "isPacketListCaptureCyclic":"true", "packetListMaxSizeMB":"2", "minNumOfPaketListSpace":"2", "isCleanupEnabled":"true/false" }</pre>

Response

HTTP Response Code	204 - No Content
HTTP Headers	
HTTP Body	

Get Configuration**Request**

URL	http://ip:port/shunra/api/configuration
HTTP Method	GET
HTTP Headers	Accept: application/json
HTTP Body	

Response

HTTP Response Code	200-OK
HTTP Headers	

HTTP Body	<pre>{ "isOverrideIP": "false", "isRouterModeOn": "true", "isPacketListCaptureCyclic": "true", "packetListMaxSizeMB": "2" }</pre>
-----------	---

Transaction Manager

The following are the API functions for Transaction Manager:

- ◆ **Connect**
- ◆ **Disconnect**
- ◆ **StartTransaction**
- ◆ **StopTransaction**

Connect

This message is sent to the vCat when the Transaction Manager connects to an emulation that is currently running.

Parameters:

- ◆ **clientIdIdentifier:** The Transaction Manager client's IP address.; it should be a valid IPv4 address. Used by the server to connect when the Endpoint Identifier is not given, and to determine whether the client is already connected.
- ◆ **overwriteExistingConnection:** A boolean flag that indicates whether or not to overwrite an existing connection.
- ◆ **endpointIdentifier:** (Optional) The ID of the Endpoint we wish to connect to from the Transaction Manager. If a localhost connection is used then this parameter can be omitted.

Return value:

Request

URL	http://ip:port/shunra/api/transactionmanager
HTTP Method	POST
HTTP Headers	Content-Type: application/json Accept: application/json
Body	{"endpointIdentifier":"ID_SERVER","clientIdIdentifier":"172.30.2.99","overwriteExistingConnection":true"}
Response	
HTTP Response Code	200 OK
HTTP Headers	Date: Thu, 15 Mar 2012 15:36:11 GMT Content-Type: application/json; charset=UTF-8 Accept-Ranges: bytes
HTTP Body	{"transactionManagerSessionIdentifiers":{"tmSessionHandle":"Aead518af-3fa3-460c-9be5-fc3b6a7101cfB","emulationHandle":"bf681884-aa3c-4164-b23b-c95918ce6ad0","tmClientEndpointId":"ID_SERVER","tmClientHostName":"127.0.0.1","topologyWithPacketLists":true}}

Disconnect

This method disconnects the Transaction Manager from the emulation engine.

Parameters:

- ✦ **transactionManagerSessionIdentifiers:** Transaction manager session identifiers, as given during "Connect". These identifiers will be used during the whole session (connect, start and end transaction and disconnect).

Return value:

Request

5-46

vCat for Mobile Manual

Chapter 5

URL	http://ip:port/shunra/api/transactionmanager
HTTP Method	PUT
HTTP Headers	Content-Type: application/json Accept: application/json
Body	{ "transactionManagerSessionIdentifiers": { "tmSessionHandle": "Aead518af-3fa3-460c-9be5-fc3b6a7101cfB", "emulationHandle": "bf681884-aa3c-4164-b23b-c95918ce6ad0", "tmClientEndpointId": "ID_SERVE R", "tmClientHostName": "127.0.0.1", "topologyWithPacketLists": true } }
Response	
HTTP Response Code	204 No Content
HTTP Headers	Date: Thu, 15 Mar 2012 16:09:31 GMT Connection: keep-alive Content-Length: 0 Server: Restlet-Framework/2.0.10 Content-Type: application/octet-stream; charset=UTF-8 Cache-Control: no-cache, no-store Accept-Ranges: bytes
HTTP Body	

StartTransaction

Marks the "start transaction" action in the emulation engine.

Note: A one second timeout must be applied between the 'StartTransaction' command and the start of the actual transaction.

Parameters:

✦ **transactionName:** The transaction name

- ◆ **transactionManagerSessionIdentifiers:** Transaction manager session identifiers, as given during Connect. These identifiers will be used during the whole session (connect, start and end transaction and disconnect).

Return value:

- ◆ **transactionIdentifiers:** The transaction identifiers, it is used in stop transaction command.

Request

URL	http://ip:port/shunra/api/transactionmanager/transaction
HTTP Method	POST
HTTP Headers	Content-Type: application/json Accept: application/json
Body	{ "transactionName": "transaction1", "transactionManagerSessionIdentifiers": { "tmSessionHandle": "Aead518af-3fa3-460c-9be5-fc3b6a7101cfB", "emulationHandle": "bf681884-aa3c-4164-b23b-c95918ce6ad0", "tmClientEndpointId": "ID_SERVER", "tmClientHostName": "127.0.0.1", "topologyWithPacketLists": true } }

Response

HTTP Response Code	200 OK
HTTP Headers	Date: Thu, 15 Mar 2012 15:55:38 GMT Transfer-Encoding: chunked Connection: keep-alive Server: Restlet-Framework/2.0.10 Content-Type: application/json; charset=UTF-8 Cache-Control: no-cache, no-store Accept-Ranges: bytes

HTTP Body

```
{"transactionIdentifiers":{"startTransactionTimestamp":1331826938560,"startTransactionName":"transaction1"}}
```

StopTransaction

Marks the "stop transaction" action in the emulation engine.

Parameters:

- ◆ **transactionDescription:** The transaction description
- ◆ **Passed:** A Boolean flag indicating passed or failed transaction
- ◆ **transactionIdentifiers:** The transaction identifiers, it is used in stop transaction command.
- ◆ **transactionManagerSessionIdentifiers:** Transaction manager session identifiers, as given during Connect. These identifiers will be used during the whole session (connect, start and end transaction and disconnect).

Return value:**Request**

URL	http://ip:port/shunra/api/transactionmanager/transaction
HTTP Method	PUT
HTTP Headers	Content-Type: application/json Accept: application/json
Body	<pre>{"transactionDescription":"login","passed":"true","transactionIdentifiers":{"startTransactionTimestamp":1331826938560,"startTransactionName":"transaction1"},"transactionManagerSessionIdentifiers":{"tmSessionHandle":"Aead518af-3fa3-460c-9be5-fc3b6a7101cfB","emulationHandle":"bf681884-aa3c-4164-b23b-c95918ce6ad0","tmClientEndpointId":"ID_SERVER","tmClientHostName":"127.0.0.1","topologyWithPacketLists":true}}</pre>

Response

HTTP Response Code	204 No Content
HTTP Headers	Date: Thu, 15 Mar 2012 16:05:34 GMT Connection: keep-alive Content-Length: 0 Server: Restlet-Framework/2.0.10 Content-Type: application/octet-stream; charset=UTF-8 Cache-Control: no-cache, no-store Accept-Ranges: bytes
HTTP Body	

License Manager

The following are the API functions for Transaction Manager:

- ◆ **Get Installed Products' Information**
- ◆ **Get Local License Servers**
- ◆ **Checkout License from the Local License Server**
- ◆ **Check-in License to the Local License Server**

Get Installed Products' Information

This API returns license information regarding all Shunra products that have been installed on the machine.

Get Information about a Specific Product

This API returns license information regarding a specific Shunra product that has been installed on the machine.

Parameters:

productkey - Shunra product ID; this parameter is used when requesting specific product information.

5-50

*vCat for Mobile Manual***Chapter 5****Return value:****installedProduct** - the installed product's name.**Request**

URL	http://ip:port/shunra/api /license/products/ { productkey }
HTTP Method	GET
HTTP Headers	Content-Type: application/json Accept: application/json
Body	
Response	
HTTP Response Code	200 OK
HTTP Headers	Date: Thu, 15 Mar 2012 15:55:38 GMT Content-Type: application/json; charset=UTF-8 Accept-Ranges: bytes

**HTTP
Body**

```

{
  "productSummary": {
    "name": "Shunra vCat for Mobile",
    "description": "Shunra vCat for Mobile",
    "version": "${env.APPLICATION_VERSION}",
    "buildVersion": "${env.APPLICATION_BUILD} "
  },
  -
  "licenseSpecification": {
    "productKey": "66",
    "isCheckoutAllowed": false,
    "haspId": "1118888129969594216",
    "isCheckedOut": false,
    "isExpired": false,
    "fingerprint_change": null,
    "productFeatures": {
      "23": {
        "name": "Run network emulation",
        "friendlyName": "Run network emulation",
        "id": "23",
        "type": "Trial",
        "value": "Not Started",
        "internalValue": "1970 1 3 0:0:0"
      },
      -
      "24": {
        "name": "Utilize packet lists",
        "friendlyName": "Utilize packet lists",
        "id": "24",
        "type": "Trial",
        "value": "Not Started",
        "internalValue": "1970 1 3 0:0:0"
      },
    },
  },
  -
  "24": {
    "name": "Utilize packet lists",
    "friendlyName": "Utilize packet lists",
    "id": "24",
    "type": "Trial",
    "value": "Not Started",
    "internalValue": "1970 1 3 0:0:0"
  },
},

```

```

-
    "66": {
      "name": "Access global library",
      "friendlyName": "Access global library",
      "id": "66",
      "type": "Trial",
      "value": "Not Started",
      "internalValue": "1970 1 3 0:0:0"
    },
-
    "67": {
      "name": "Run analytics",
      "friendlyName": "Run analytics",
      "id": "67",
      "type": "Trial",
      "value": "Not Started",
      "internalValue": "1970 1 3 0:0:0"
    },
-
    "68": {
      "name": "Run multi-user mode",
      "friendlyName": "Run multi-user mode",
      "id": "68",
      "type": "Trial",
      "value": "Not Started",
      "internalValue": "1970 1 3 0:0:0"
    },
-
    "69,72,73,74,75,76,77,78": {
      "name": "Maximum number of concurrent
test flows",
      "friendlyName": "Maximum number of
concurrent test flows",
      "id": "69,72,73,74,75,76,77,78",
      "type": "Trial",
      "value": "Not Started",
      "internalValue": "10"
    }
-
  }
-
}
-
}

```

Get Information about all Installed Products

This API returns the names of all Shunra products that have been installed on the machine.

Parameters:

Return value:

installedProducts - the installed products' description.

Request

URL	http://ip:port/shunra/api /license/products
HTTP Method	GET
HTTP Headers	Content-Type: application/json Accept: application/json
Body	
Response	
HTTP Response Code	200 OK
HTTP Headers	Date: Thu, 15 Mar 2012 15:55:38 GMT Content-Type: application/json; charset=UTF-8 Accept-Ranges: bytes

**HTTP
Body**

```

{
  "installedProducts": {
    "43": {
      "productSummary": {
        "name": "Shunra Analytics",
        "description": "Shunra Analyzer",
        "version": "8.5",
        "buildVersion": "0.52 "
      },
      -
      "licenseSpecification": {
        "productKey": "43",
        "isCheckoutAllowed": false,
        "haspId": "1011823765196572976",
        "isCheckedOut": false,
        "isExpired": false,
        "fingerprint_change": null,
        "productFeatures": {
          "20": {
            "name": "Allow to Run Analytics",
            "friendlyName": "Allow to Run
Analytics",
            "id": "20",
            "type": "Trial",
            "value": "Not Started",
            "internalValue": "1970 1 3 0:0:0"
          }
        }
      },
      -
    },
    -
  },
  -
  "66": {
    "productSummary": {
      "name": "Shunra vCat for Mobile",
      "description": "Shunra vCat for Mobile",
      "version": "8.5",
      "buildVersion": "0.123 "
    },
    -
  },
  -
}

```

```

    },
    -
    "licenseSpecification": {
      "productKey": "66",
      "isCheckedOut": false,
      "haspId": "1087849214784939015",
      "isCheckedOut": false,
      "isExpired": false,
      "fingerprint_change": null,
      "productFeatures": {
        "23": {
          "name": "Run network emulation",
          "friendlyName": "Run network
emulation",
          "id": "23",
          "type": "Trial",
          "value": "Not Started",
          "internalValue": "1970 1 3 0:0:0"
        },
        -
        "24": {
          "name": "Utilize packet lists",
          "friendlyName": "Utilize packet
lists",
          "id": "24",
          "type": "Trial",
          "value": "Not Started",
          "internalValue": "1970 1 3 0:0:0"
        },
        -
        "66": {
          "name": "Access global library",
          "friendlyName": "Access global
library",
          "id": "66",
          "type": "Trial",
          "value": "Not Started",
          "internalValue": "1970 1 3 0:0:0"
        },

```

```

-
"67": {
  "name": "Run analytics",
  "friendlyName": "Run analytics",
  "id": "67",
  "type": "Trial",
  "value": "Not Started",
  "internalValue": "1970 1 3 0:0:0"
},
-
"68": {
  "name": "Run multi-user mode",
  "friendlyName": "Run multi-user mode",
  "id": "68",
  "type": "Trial",
  "value": "Not Started",
  "internalValue": "1970 1 3 0:0:0"
},
-
"69,72,73,74,75,76,77,78": {
  "name": "Maximum number of concurrent
test flows",
  "friendlyName": "Maximum number of
concurrent test flows",
  "id": "69,72,73,74,75,76,77,78",
  "type": "Trial",
  "value": "Not Started",
  "internalValue": "10"
}
-
}
-
}
-
}
-
}
-
}
-
}

```

Get Local License Servers

This API returns information about all the machines that:

- ◆ are visible in the network segment
- ◆ support checkout license operation for the installed product
- ◆ have appropriate license pool installed

Parameters:

productkey: The ID of the Shunra product for which the License Server should support checkout of licenses.

Return value:

licenseServers - the name (descriptors) of the visible local License Servers that have product license pools, supporting checkout of licenses.

Request

URL	http://ip:port/shunra/api /license/servers/ { productkey }
HTTP Method	GET
HTTP Headers	Content-Type: application/json Accept: application/json
Body	
Response	
HTTP Response Code	200 OK
HTTP Headers	Date: Thu, 15 Mar 2012 15:55:38 GMT Content-Type: application/json; charset=UTF-8 Accept-Ranges: bytes

5-58

vCat for Mobile Manual

Chapter 5**HTTP
Body**

```

{
  "licenseServers": [(3)
    {
      "hostname": "IL-IGOR-VM",
      "ip": "127.0.0.1",
      "osname": "Windows 7 Enterprise",
      "osversion": "Build 7601",
      "version": "13.20.1.22521",
      "name": "IL-IGOR-VM",
      "architecture": "Intel64 Family 6 Model 42
Stepping 7",
      "fingerprint": "MXhJScsMEdMkCs9YNU1SMENI6Df
mlPJiiZvnFGt3LvBtEDS4f6lwBO45atQMiPI=",
      "id": "7EgOQpiUdFBwdnsrgq10drS84DaN/
Ue2lUa7f1UA",
      "uptime": "831",
      "time": "1348155642"
    },
    -
    {
      "hostname": "2008-SP2-64",
      "ip": "172.30.2.30",
      "osname": "Windows Server (R) 2008 Standard
without Hyper-V",
      "osversion": "Build 6002",
      "version": "13.20.1.22521",
      "name": "IL-IGOR-VM",
      "architecture": "Intel64 Family 6 Model 26
Stepping 5",
      "fingerprint": "MXhJSemJkxxaGajYvejmqEAKlZj
lxj3iCOkY+InD5IyuNJ0VwhTNf72M5siAaSJVXOKkXHL3nsC
/eAQnxTkX",
      "id": "MxO5Y6fU5aFqEZn8H8O2BGUFxvaM05q3vUui
CYcA",
      "uptime": "3288917",
      "time": "1348155545"
    },
    -
    {

```

```

        "hostname": "HV2-764",
        "ip": "172.30.2.44",
        "osname": "Windows 7 Enterprise",
        "osversion": "Build 7601",
        "version": "13.20.1.22521",
        "name": "IL-IGOR-VM",
        "architecture": "Intel64 Family 6 Model 23
Stepping 10",
        "fingerprint": "MXhJScsUEdKkD8pYNU3SMcNI+Df
mlvJugRvllOhxDvBNEDWof7FoBOY5a9aMiDI=",
        "id": "+5ucgiEKV2VGIsG9ga2CFP27xQCCAGyOc3c2
siUA",
        "uptime": "163308",
        "time": "1348155640"
    }
  -
]
-
}

```

Checkout License from the Local License Server

This API allow checkout of a license from License Server visible on the network segment, which has an appropriate product license pool. The API is asynchronous and has two stages:

- 1 Checkout request
- 2 Get checkout operation status

Checkout License

This API initiates checkout of a license.

Body:

checkoutParameters - The configuration of the checkout operation. It includes:

- ◆ "Product key
- ◆ "Duration in seconds
- ◆ "IP of the local license server

Return value:

5-60

vCat for Mobile Manual

Chapter 5**Request**

URL	http://ip:port/shunra/api /license/checkout
HTTP Method	POST
HTTP Headers	Content-Type: application/json Accept: application/json
Body	{"productKey":"43","duration":1036800,"ip":"172.30.2.30"}

Response

HTTP Response Code	200 OK
HTTP Headers	Date: Thu, 15 Mar 2012 15:55:38 GMT Content-Type: application/json; charset=UTF-8 Accept-Ranges: bytes
HTTP Body	

Checkout Status

The API validates the status of the license currently being checked out.

Parameters:

productkey - The ID of the Shunra product for which the checkout is going to occur.

Return value:

LicenseModificationStatus - the status and the error description (if an error occurred during the checkout). The possible statuses are:

```
// a job still has not been started
Idle(0),
// a job started
Started(1),
// a job finished
```

```

    Finished(2),
    // a job failed
    Failed(3);

```

Request

URL	http://ip:port/shunra/api /license/checkout/ {productkey}
HTTP Method	GET
HTTP Headers	Content-Type: application/json Accept: application/json
Body	
Response	
HTTP Response Code	200 OK
HTTP Headers	Date: Thu, 15 Mar 2012 15:36:11 GMT Content-Type: application/json; charset=UTF-8 Accept-Ranges: bytes
HTTP Body	{ "statusDescription": null, "licenseStatus": "Finished" }

Check-in License to the Local License Server

This API allows check in of a license back to a visible license server which has an appropriate product license pool. The API is asynchronous and has two stages:

- 1** Checkin request
- 2** Get checkin status

Check In License

This API initiates the checkout license operation.

5-62

*vCat for Mobile Manual***Chapter 5****Body:**

checkinParameters - The configuration of the check in operation; it includes the product ID, and also which license has been checked out from the pool.

Return value: -

Request

URL	http://ip:port/shunra/api /license/checkin
HTTP Method	POST
HTTP Headers	Content-Type: application/json Accept: application/json
Body	{"productKey":"43"}
Response	
HTTP Response Code	200 OK
HTTP Headers	Date: Thu, 15 Mar 2012 15:36:11 GMT Content-Type: application/json; charset=UTF-8 Accept-Ranges: bytes
HTTP Body	

Check In Status

This API validates the current status of the license currently being checked in.

Parameters:

productkey - The ID of the Shunra product for which the license check in is going to occur.

Return value:

LicenseModificationStatus - the status and the error description (if an error occurred during the license check in).

The possible statuses are:

```
// a job still has not been started
Idle(0),
// a job started
Started(1),
// a job finished
Finished(2),
// a job failed
Failed(3);
```

Request

URL	http://ip:port/shunra/api /license/checkin// { productkey }
HTTP Method	GET
HTTP Headers	Content-Type: application/json Accept: application/json
Body	
Response	
HTTP Response Code	200 OK
HTTP Headers	Date: Thu, 15 Mar 2012 15:36:11 GMT Content-Type: application/json; charset=UTF-8 Accept-Ranges: bytes
HTTP Body	{ "statusDescription": null, "licenseStatus": "Finished" }

5-64

vCat for Mobile Manual

Chapter 5

6

vCat for Mobile Command Line Interface

The vCat for Mobile Command Line Interface (CLI) is included in the vCat for Mobile installation. It delivers an API for almost all functionality that is available via vCat for Mobile's web services, with the exception of the Transaction Manager functionality and online statistics. It requires that the vCat Server is up and running.

Note: Only absolute paths (not relative paths) can be entered for files required by the CLI.

To obtain help for a command:

type: `vcatchli <command> -help`

Commands

The following commands are available:

- ◆ **DownloadExternalEvents**
- ◆ **DownloadShunraFile**
- ◆ **SetConfiguration**
- ◆ **StartAdvanceEmulation**
- ◆ **GetActiveAdapter**
- ◆ **GetEmulationParameters**
- ◆ **DownloadPL**
- ◆ **GetExcludeRanges**
- ◆ **SetActiveAdapter**
- ◆ **GetServerConfiguration**
- ◆ **StopEmulation**

- ◆ StartCapture
- ◆ StopCapture
- ◆ IsCapturing
- ◆ UpdateEmulation
- ◆ StartEmulation
- ◆ GetIdentifiers
- ◆ ResetDriver
- ◆ DeleteExcludeRange
- ◆ AddExcludeRange
- ◆ GetPacketListIds
- ◆ GetProductVersion
- ◆ UpdateAdvanceEmulation
- ◆ StartCapture

DownloadExternalEvents

Downloads external events file from the vCat for Mobile server.

Usage: DownloadExternalEvents [options]

Options

- | | |
|------------------|---|
| -f, -force | Overrides the destination file if a destination file exists (default: false) |
| -file | Destination file name for resource download (existing file will be overridden)
(-file <file path>) |
| -identifier, -id | Emulation identifier (-id <emulation_id>) |

DownloadShunraFile

Downloads .shunra file from the vCat for Mobile server.

Note: A two second timeout must be applied between the time a transaction stops (all traffic has ended) and before this command is used, otherwise not all of the transaction data will be included in the packet list.

Usage: DownloadShunraFile [options]

Options

-f, -force	Overrides the destination file if a destination file exists (default: false)
-file	Destination file name for resource download (existing file will be overridden) (-file <file path>)
-identifier, -id	Emulation identifier (-id <emulation_id>)
-plID	Identifier of a packet list (-plID <pl_id>)

SetConfiguration

Sets vCat for Mobile server's configuration.

Usage: SetConfiguration [options]

Options

-cyclic	Should Packet List Capturing be cyclic (-cyclic <true false>)
-enableCleanup	Enable or disable the cleanup of historic data (-enableCleanup <true false>)
-minNumOfPacketListSpace	The threshold of packet lists size (default: 3)
-overrideIP	Turn on/off override IP feature (-overrideIP <true false>)
-packetListMaxSize	The Max size of Packet List in MB (default: 100) (must be in range 1-1000) (-packetListMaxSize <val>) (default: -2147483648)
-routerModeOn	Should the vCat server work in router mode (-routerModeOn <true false>)

StartAdvanceEmulation

Start Advanced mode emulation.

Usage: StartAdvanceEmulation [options]

Option

- bw, -bandwidth Bandwidth restriction. Must be in range of 2.4-10 GB
When this parameter is missing, unrestricted
bandwidth is assumed
(-bw <value >) (default: -2.147483648E9)
- capturePL Should emulation capture client's packet list (-
capturePL) (default: false)
- lat, -latency Fixed latency for emulation, must be an integer in
range 0-8000. (-latency <value>) (default: 0)
- loss Packet loss rate, must be a number in range 0.0-90.0.
(-loss <value>) (default: 0.0)

GetActiveAdapter

Get Active adapter configured on the vCat for Mobile server.

Usage: GetActiveAdapter [options]

GetEmulationParameters

Gets current emulation parameters.

Usage: GetEmulationParameters [options]

DownloadPL

Downloads the packet list from the vCat for Mobile server.

Note: A two second timeout must be applied between the time a transaction stops (all traffic has ended) and before this command is used, otherwise not all of the transaction data will be included in the packet list.

Usage: DownloadPL [options]

Option

-f, -force	Overrides the destination file if such exists.
-file	Destination file name for resource download (will be overridden) (-file <file path>)
-identifier, -id	Emulation identifier (-id <emulation_id>)
-plID	Identifier of a packet list (-plID <pl_id>)

GetExcludeRanges

Get server's automatically excluded ranges

Usage: GetExcludeRanges [options]

SetActiveAdapter

Sets the Active adapter on the vCat for Mobile server

Usage: SetActiveAdapter [options]

Option

ip, -IP	Active adapter IP (-ip <IP>)
-rd, -RD	Reverse directions (-rd <RD>) (default: false)

GetServerConfiguration

Gets the product's configuration information.

Usage: GetServerConfiguration [options]

StopEmulation

Stops current emulation.

Option

identifier, -id Emulation identifier (-id <emulation_id>)

Note: A two second timeout must be applied between the time a transaction stops (all traffic has ended) and before this command is used, otherwise not all of the transaction data will be included in the packet list.

StartCapture

Usage: StartCapture [options]

Options

-id Identifier of a packet list that should be captured (-id <id>).
* Don't use this option if global capture is required.

StopCapture

Usage: StopCapture [options]

Options

-id Identifier of a packet list that should stop being captured. (-id <id>).
* Don't use this option if global capture is required.

IsCapturing

Gets the status of the Packet List capture.

Usage: IsCapturing [options]

Option

Identifier of a packet list whose status is being queried.

(-id <id>).

* Don't use this option if global capture is required.

UpdateEmulation

Usage: UpdateEmulation [options]

Option

-file Path to the location of the network file
(-file <file>)

-identifier, -id Emulation identifier
(-id <emulation_id>)

StartEmulation

Usage: StartEmulation [options]

Option

-file Path to the location of the network file
(-file <file>)

GetIdentifiers

Gets identifiers of all currently running emulations.

Usage: GetIdentifiers [options]

ResetDriver

Resets the vCat for Mobile driver which stops all currently running emulations.

Usage: ResetDriver [options]

DeleteExcludeRange

Removes a specific excluded range from the configuration.

Usage: DeleteExcludeRange [options]

Option

-from, -fromIp	IP which identifies the beginning of the excluded range(-from <IP>)
-port	Port number to be excluded (defaults to 'all') (-port <port_number>) (default: 0)
-protocol	Protocol ID to be excluded (defaults to 'all') (-protocol <protocol_number>) (default: 0)
-to, -toIp	IP which identifies the end of the excluded range (-from <IP>)

AddExcludeRange

Adds a specific excluded range to the configuration.

Usage: AddExcludeRange [options]

Option

-from, -fromIp	IP which identifies the beginning of the exclude range(-from <IP>)
-port	Port number to be excluded (defaults to 'all') (-port <port_number>) (default: 0)
-protocol	Protocol id to be excluded (defaults to 'all') (-protocol <protocol_number>) (default: 0)
-to, -toIp	IP which identifies the end of the exclude range (-from <IP>)

GetPacketListIds

Gets the Packet Lists IDs from current or previous emulations.

Usage: GetPacketListIds [options]

Option

-identifier, -id Emulation identifier (-id <emulation_id>)

GetProductVersion

Gets the version number of the product.

Usage: GetProductVersion [options]

UpdateAdvanceEmulation

Updates advanced mode emulations that are already playing.

Usage: UpdateAdvanceEmulation [options]

Option

-bw, -bandwidth Bandwidth restriction. Must be in range of 2.4-100000.0
 When this parameter is missing, unrestricted bandwidth is assumed
 (-bw <value >) (default: -2.147483648E9)

-identifier, -id Emulation identifier (-id <emulation_id>)

-lat, -latency Fixed latency for emulation, must be an integer in range 0-8000.
 (-latency <value>)
 (default: 0)

-loss Packet loss rate, must be a number in range 0.0-90.0.
 (-loss <value>)
 (default: 0.0)

DeleteAllExcludeRanges

Deletes all automatically excluded ranges.

Usage: DeleteAllExcludeRanges [options]

7

Network Emulation Specifications

The following impairments can be configured in the Shunra Network Editor.

WAN Shape Impairments	
Latency	
Fixed Latency	0–1000 ms (Granularity =1 ms)
Uniform Distributed Latency (minimum/maximum)	0–8000 ms (Granularity =1 ms)
Normal Distributed Latency:	
Average	0–8000 ms (Granularity =1 ms)
Standard Deviation	0–8000 ms (Granularity =1ms)
Linear latency (minimum/maximum):	0–8000 ms (Granularity =1 ms)
Cycle Duration	1–65535 sec
Packet Loss	
Periodic Loss - Lose Every n^{th} packet	$n=2-65535$
Random Loss	0–10% (Granularity =0.01%)
Burst Loss:	
Probability	0.01–90% (Granularity =0.01%)

7-2

vCat Manual

Chapter 7

Burst Size	1–65534 packets
Gilbert-Elliot Loss Two State Loss Model:	
Loss Probability	0.0 – 100% (Granularity =0.01%)
Transition to Other State	0.0 – 99.99% (Granularity =0.01%)
Packet Effects:	
Out Of Order:	
Probability	1–50%
Offset	1–64 packets
Packet Duplication:	
Probability	1–99%
Number of duplicates	1–20 packets
Fragmentation:	
Chance	1–99%
MTU	64–1460 bytes
DF Policy	Ignore DF and fragment packet. Discard packet and generate ICMP message. Discard packet and do not send a message.
Link Faults:	
Bit Error	
Frequency	$1/10^2$ – $1/10^{12}$ bits
Number of Toggled Bits	1–500 bits

Disconnection:	
Average Frequency	3–300 sec
Disconnection Time	10–30000 ms
Congestion:	
Frequency	1–300 sec
Time span	10–65535 ms
Event Properties:	
Fixed Latency	0–8000 ms
Packet Loss Probability	0%–90% (Granularity = 0.01%)
Gateway Specifications	
Symmetric Bandwidth	1–10 GB
Asymmetric Bandwidth:	
Uplink/Downlink	1–10 GB
Packet Overhead Length	0–1000 bytes
Incoming/Outgoing Queue Limitations	
Queue Size	2–65535 KB
Queue Size Policy	Packet Mode or Byte Mode
Queue Management	Drop Tail or RED
RED Queue (Minimum/Maxim Threshold)	2–65535 KB
Traffic Type Support	
Traffic	IPv4 IPv6

EXHIBIT D



Data Sheet

Application Development, Test & Delivery

Network Virtualization

Your business depends on your applications. So your mobile and Web apps have to work right—and perform well. But testing application performance in your lab doesn't tell you what users will experience when you deploy the app over the production network.

Product Highlights

Micro Focus® Network Virtualization software lets you test application performance under real world network conditions, identify bottlenecks, and optimize the code—before you deploy it.

Network Virtualization software allows you to discover and capture real-world network performance conditions from your production network, recreate network conditions in your lab during application testing, and optimize the applications to improve performance before you deploy into production.

Discover Network Conditions

Your network is complex and continually evolving. So the first step in network virtualization for software performance testing is to discover how network constraints affect communication between end users, the application, and its dependencies.

Network Virtualization Global Library

Start with the Network Virtualization Global Library. It's a library of ready-to-use mobile and broadband network conditions providing real-world Internet and last-mile condi-

Key Capabilities

With Network Virtualization software you can:

- Enable each load generator to emulate a different network location's transaction response time, and reduce or eliminate reliance on remote load generators
- Aggregate test results into a single database for ease and completeness of analysis
- Extend performance testing scripts with a single click
- Automate reporting and analysis for performance engineers, line of business owners, and other business constituents
- Integrate in VuGen and controller

Micro Focus Network Virtualization Supports

- Windows 7/8/10/2008/2012 operating systems and 64-bit for all platforms
- Linux Ubuntu and Red Hat operating systems (Network Virtualization 9.x product only)
- Bandwidth emulation up to 100 Mbps or unlimited
- Granular IP filtering (by protocol, port)
- Expanded packet capture (up to 1 GB)
- Micro Focus Network Virtualization Global Library
- Micro Focus Network Capture

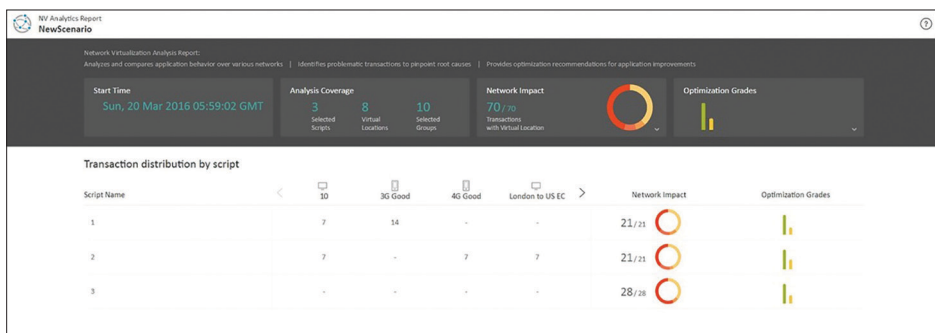


Figure 1. Analyst Report

Accurate Measurements

Network Virtualization simulates real-world network conditions to enable accurate analysis of user response time and throughput.

tions for thousands of cities worldwide. You specify a server and client location to obtain sample network conditions connecting those locations.

Data Sheet

Network Virtualization

The data in the library represents the results of end-user network tests executed globally in both desktop browsers and on tablets and smartphones. The raw data comprises results from more than 5 billion end-user tests covering up to 6000 client locations and up to 100 server locations. They are categorized based on the type of network connection and other characteristics.

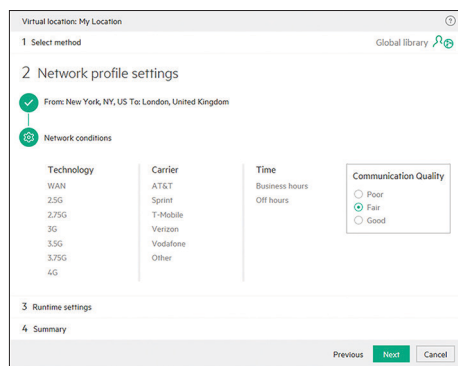


Figure 2. Virtual Location in the Global library

Network Capture Server

Micro Focus Network Capture—a component of Network Virtualization software—lets you easily and accurately record, import, and replay real-world network performance behavior, including conditions such as latency, packet loss, and available bandwidth. It is accessed remotely using a browser.



Figure 3. Network Capture

With Network Capture you record network performance conditions from clients or servers to

other targets. You can record and profile conditions between data centers, remote offices, and remote workers and then replay them with Network Virtualization software for testing. The network conditions typically cover client-to-server connections for applications such as Web, SAP, and virtual desktop infrastructure as well as server-to-server environments.

Network Capture Express Mobile App

The Network Capture express mobile app is available free for both iOS and Android platforms from the appropriate app store. It enables you to test latency, packet loss, and bandwidth on a mobile device and then share the profile for use in Network Virtualization software tests. You can configure the app to test for between 1 and 15 minutes, and it will repeatedly test latency, resulting packet loss, and download bandwidth in cycles.

The app sends ICMP ping requests to the remote server to measure latency and loss. Bandwidth measurements use servers hosted in the Internet to download data to the mobile device. Since the mobile network bottleneck is usually located in the last mile between the mobile device and the cellular provider, this provides a good approximation of the bandwidth limits of the connected network.

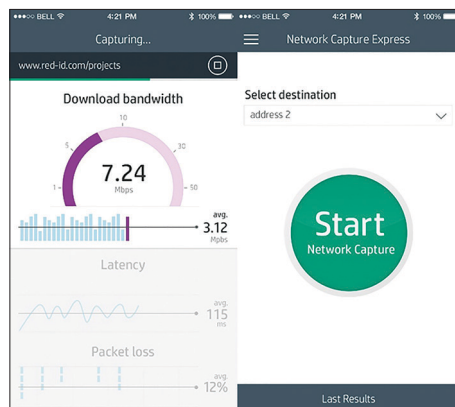


Figure 4. Approximation of the bandwidth limits view

Key Benefits

Web, mobile, and cloud network conditions are dynamic and vary by provider, location, and time of day. So your test environment must accurately recreate multiple network scenarios to analyze application performance and the effect of network conditions on different user populations. Network Virtualization software can virtualize real-world network conditions including bandwidth, latency, jitter, and packet loss on multiple platforms alongside all test activities.

Network Virtualization

Network Virtualization software integrates seamlessly with Micro Focus LoadRunner, Micro Focus Performance Center, Micro Focus Mobile Center, Micro Focus StormRunner Load, and Micro Focus Unified Functional Testing software to improve the accuracy of load, performance, and functional tests. It accelerates application performance testing across WANs, the Web, mobile networks, and the cloud.

The solution's unique interface, integrated within the familiar LoadRunner, Performance Center, and StormRunner Load GUIs, makes it easy to configure and use. Network Virtualization software requires no script editing and places no limits on test scheduling. In addition, test results and data are automatically stored and organized by emulated location for precise and actionable analysis.

Load generators can emulate multiple locations, each with a unique set of network conditions. That lets you simultaneously emulate multiple user populations and more accurately recreate the real-world conditions affecting the end-user experience.

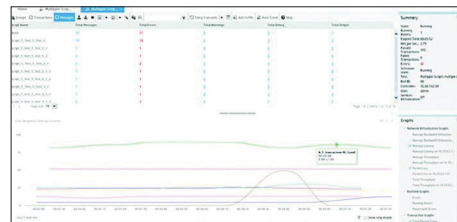


Figure 5. Performance Center dashboard

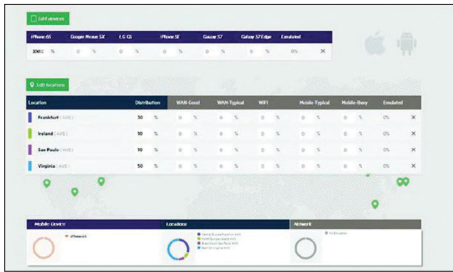


Figure 6. StormRunner dashboard

Mobile Application Testing

Network Virtualization software works seamlessly with Mobile Center to accurately verify the performance mobile users will experience when using an app on the real mobile network. Mobile devices under test are connected via Wi-Fi and send mobile traffic via Network Virtualization software using a proxy. Mobile Center includes simple definitions of the network performance conditions to be simulated for each test device independently, and it manages the API calls to Network Virtualization software to apply the conditions during testing across multiple mobile devices simultaneously.

Flexible Deployment Options

In addition to being integrated with the Micro Focus performance test products and running on the load generators, Network Virtualization software can also be deployed on the system hosting the application under test or in virtual appliance mode on a dedicated physical server. In virtual appliance mode, network traffic to and from the application is routed through the server hosting Network Virtualization software which applies the specified network impairments to the actual traffic.

Location-Aware Analytics

Network Virtualization software provides deep-dive analytic capabilities and location-specific network performance information. It helps you identify poorly performing business transactions and the root cause of

performance issues. It provides service level and performance compliance reporting, and it is closely integrated with Micro Focus performance test products.

Key Features

While Network Virtualization software supports accurate prediction of the networked performance of applications before you deploy them, Network Virtualization Analytics lets you drill down into the root cause of performance issues, and it provides recommendations for optimizing Web and mobile apps.

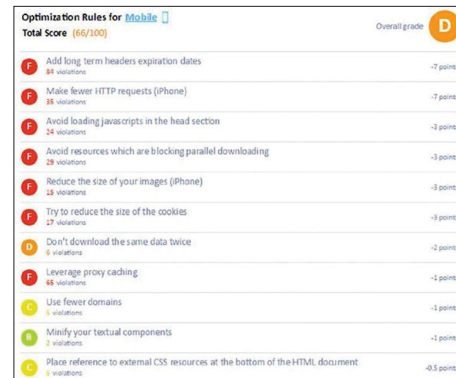


Figure 7. NV Analytics Report

Web and mobile analysis: Network Virtualization Analytics enables rapid analysis of transaction response times.

Web and Mobile Applications

In Network Virtualization Analytics, a waterfall diagram visualizes individual resource sizes and load times breaking down transaction response times, so you can quickly identify areas for optimization. These deep-dive capabilities show you how the end user experiences an application or page load and provide insight into client-network server timing by sub transaction.

Whether you are analyzing Web-based, mobile Web-based, or native mobile applications, this

information is critical to understanding the end user's perception of performance and where you should focus your optimization efforts.

Automated Optimization Recommendations

Micro Focus Application Performance Analytics provides a transaction scorecard.



Figure 8. NV Analytics Report Optimization Recommendation view

In addition to providing extensive Web and mobile analysis, Network Virtualization Analytics delivers a transaction performance scorecard that automatically grades application performance and offers custom performance optimization suggestions based on industry accepted and additional proprietary rule sets.

These performance optimization suggestions help improve the load time of mobile-optimized sites by at least 20 percent and of standard websites by a typical level of 44 percent when viewed on an iPhone. With comprehensive analysis capabilities, you can quickly and reliably identify bottlenecks and get specific recommendations for performance optimization to help you deliver applications that live up to the expectations of your users.

Transaction Analysis

Obtaining enhanced performance information on each transaction enables quick isolation of the root cause of performance problems. Network Virtualization Analytics includes the following reports to enable rapid analysis and problem diagnosis:

- The **transaction analysis report** shows how resource intensive a transaction is and enables comparison with other

Contact us at:
www.microfocus.com

applications that are consuming the same network resources.

- The **bandwidth bottleneck report** identifies throughput and bandwidth utilization for each transaction.
- The **network and application error report** highlights all application-related errors and isolates problems such as caching issues, unutilized buffer size, and other functional problems for remediation.
- The **breakdown analysis** of infrastructure shows the elapsed time an application spends on the server, the client, and the network, helping to pinpoint bottlenecks in the application infrastructure.

is captured in an industry-standard format for further analysis with Network Virtualization, or it can be easily accessed directly from the LoadRunner or Performance Center scripting interface VuGen.

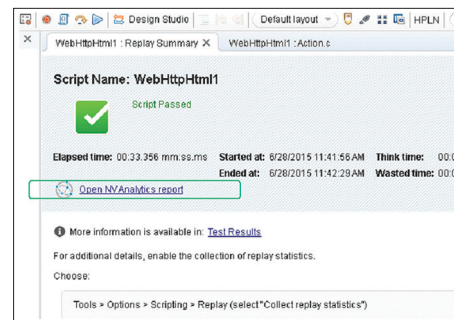


Figure 9. Test Results

Learn More At
www.microfocus.com/networkvirt

Transaction Management

With Network Virtualization Analytics, it is easy to incorporate packet capture buffers into automated test sessions and correlate business transactions with the resulting traffic traversing the network. This transaction data

EXHIBIT E



HP Network Capture

Software Version: 7.11

User Guide

Document Release Date: June 2015
Software Release Date: June 2015

EXHIBIT A--274

Legal Notices

Warranty

The only warranties for HP products and services are set forth in the express warranty statements accompanying such products and services. Nothing herein should be construed as constituting an additional warranty. HP shall not be liable for technical or editorial errors or omissions contained herein.

The information contained herein is subject to change without notice.

Restricted Rights Legend

Confidential computer software. Valid license from HP required for possession, use or copying. Consistent with FAR 12.211 and 12.212, Commercial Computer Software, Computer Software Documentation, and Technical Data for Commercial Items are licensed to the U.S. Government under vendor's standard commercial license.

Copyright Notice

© Copyright 2002 - 2015 Hewlett-Packard Development Company, L.P.

Trademark Notices

Adobe® is a trademark of Adobe Systems Incorporated.

Microsoft® and Windows® are U.S. registered trademarks of Microsoft Corporation.

UNIX® is a registered trademark of The Open Group.

Documentation Updates

The title page of this document contains the following identifying information:

- Software Version number, which indicates the software version.
- Document Release Date, which changes each time the document is updated.
- Software Release Date, which indicates the release date of this version of the software.

To check for recent updates or to verify that you are using the most recent edition of a document, go to:

<https://softwaresupport.hp.com>.

This site requires that you register for an HP Passport and sign in. To register for an HP Passport ID, go to

<https://softwaresupport.hp.com> and click **Register**.

Support

Visit the HP Software Support Online web site at: <https://softwaresupport.hp.com>

This web site provides contact information and details about the products, services, and support that HP Software offers.

HP Software online support provides customer self-solve capabilities. It provides a fast and efficient way to access interactive technical support tools needed to manage your business. As a valued support customer, you can benefit by using the support web site to:

- Search for knowledge documents of interest
- Submit and track support cases and enhancement requests
- Download software patches
- Manage support contracts
- Look up HP support contacts
- Review information about available services
- Enter into discussions with other software customers
- Research and register for software training

Most of the support areas require that you register as an HP Passport user and sign in. Many also require a support contract. To register for an HP Passport ID, go to: <https://softwaresupport.hp.com> and click **Register**.

To find more information about access levels, go to: <https://softwaresupport.hp.com/web/software-support/access-levels>.

HP Software Solutions & Integrations and Best Practices

Visit **HP Software Solutions Now** at <https://h20230.www2.hp.com/sc/solutions/index.jsp> to explore how the products in the HP Software catalog work together, exchange information, and solve business needs.

Visit the **Cross Portfolio Best Practices Library** at <https://hpln.hp.com/group/best-practices-hpsw> to access a wide variety of best practice documents and materials.

Contents

HP Network Capture	6
Which Metric Should I Choose?	8
Tips to Improve Measurement Accuracy	10
Installation and Upgrade	11
Installing Network Capture	12
System Requirements and Resource Utilization	13
Secure Communication in Network Capture	14
Network Capture Server Installation	16
Network Capture Agent Installation	18
Installing the Network Capture Agent	18
Uninstalling the Network Capture Agent	19
Firewall Configuration	19
Reverting an Installation	21
Upgrade Compatibility	22
Log and Configuration Files	23
Login	24
Licensing Network Capture	24
Changing between Secure and Non-Secure Communication Post Installation	26
Enabling Secure Communications	27
Disabling Secure Communications	28
Using Network Capture	29
Moving Around	30
Creating Endpoints	30
Configuring a Monitor	32
Adding and Deleting Monitor Folders	32
Defining the Interval for Concurrent Bandwidth Monitors	33
Configuring Latency and Packet Loss	34
Configuring Bandwidth	36
Configuring Web Server Parameters	37
Start Monitoring	38
Viewing Data	38
Zoom In and Zoom Out	41
Searching for Data	43
Analyzing Data	44
Performance Statistics	44
Using Network Profiles	45
Exporting Data	46
Defining and Updating Users	47
Account Settings	48
Setting Schedules	49
FAQs and Troubleshooting	49

Obtaining Technical Support	53
Send Us Feedback	55

HP Network Capture

HP's Network Capture records actual network conditions, enabling the import and recreation of network environments into pre-production and testing labs. In addition, Network Profiles utilize data that includes real-world network conditions of mobile and broadband Internet users from major cities around the world. This data is used to accurately assess and analyze the performance of distributed applications using HP's applications.

When you record network conditions, your goal is probably to see how your applications will react with various network parameters. Perhaps you're consolidating your data server, and want to check how various applications will behave in production network conditions. Perhaps you're testing a new feature and want to ensure that each business process will perform well in production.

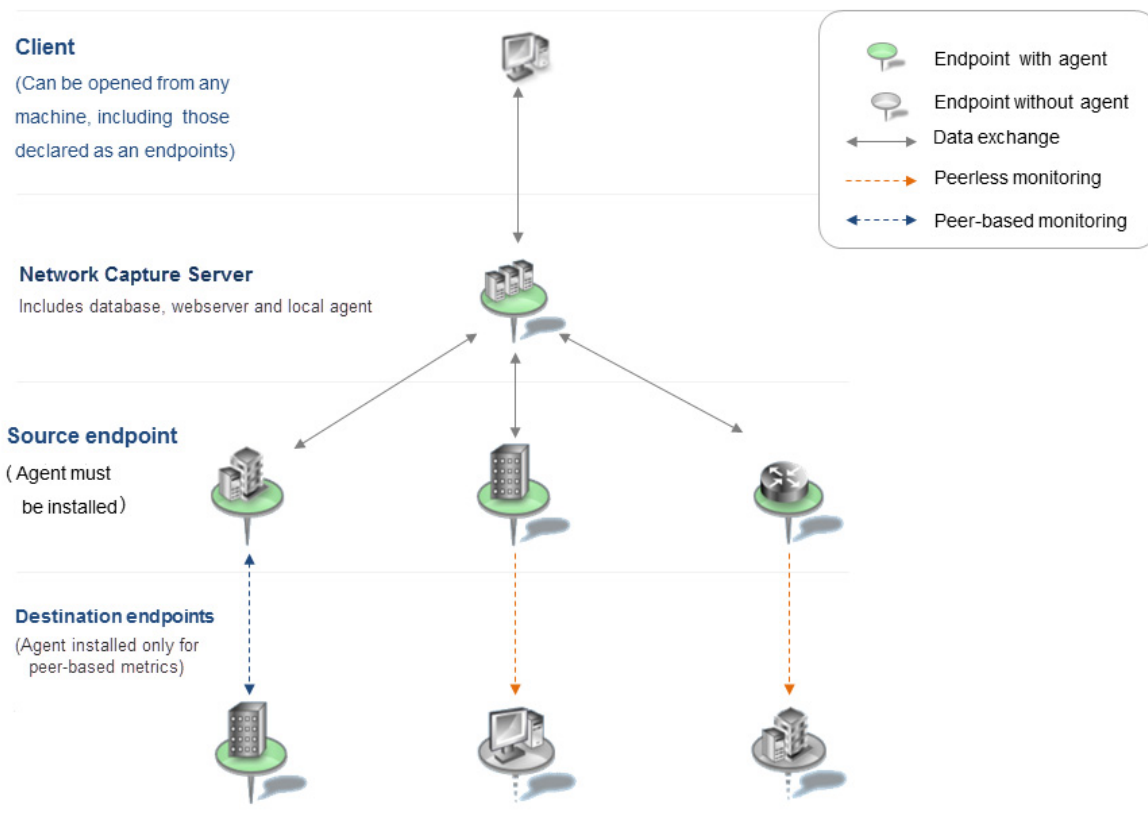
Use Network Capture to record and identify application performance problems occurring at a remote location, by measuring network conditions such as latency, packet loss, bandwidth availability across any given network topology. Network Capture can measure production links around the globe for a duration of up to one month.

After completing a recording, you can export the data for reporting purposes, or emulate these conditions in HP's network emulation products. You can export a complete run, or a specific period within the run, for example, the period with the highest latency values.

With Network Capture's web-based interface, you can record up to 25 simultaneous links (license dependent), and view the actual locations on the dynamic map. You can search easily for specific monitors, users and results. Schedule the monitors to start and stop at different times and for various durations, including recurrence if required.

Network Capture provides powerful analysis options to select the lowest, mean and highest conditions from the recorded data. A variety of measurements and calculations provide detailed information that can be used to evaluate application response time under various conditions.

This diagram shows the relationship of the components in the Network Capture configuration.



Concurrent Measurements of more than one Metric

While latency, loss and jitter can be measured concurrently, bandwidth cannot be measured in parallel, because doing so impacts the accuracy of the measurements. Therefore, Network Capture optimizes the percentage distribution, or the system overall time allocation between measurements of bandwidth and latency, packet loss and jitter.

For the best system configuration conditions, at least 75% of the measurement's duration is devoted to latency, loss and jitter measurements and up to $\pm 25\%$ to bandwidth. When measuring with the worst network configuration conditions, at least $\pm 75\%$ of the duration is devoted to latency, loss and jitter. For further information, see ["Defining the Interval for Concurrent Bandwidth Monitors" on page 33](#).

The scheduling algorithm is optimized and automatically calibrated to support a star topology, where the center (root) of the topology is set as the source of all the monitors.

See also:

- ["Which Metric Should I Choose?" on the next page](#)
- ["Tips to Improve Measurement Accuracy" on page 10](#)

Which Metric Should I Choose?

The following table compares certain features of each metric that is used to measure network conditions.

Note: All metrics are less accurate when the Endpoint is running CPU-intensive processes. Load-generating tasks should not be run on an Endpoint machine. Network accelerators and proxy servers intercepting Network Capture traffic may hinder the accuracy of the results.

Network overhead is affected by the probing interval and other factors.

Metric	Requirements	Most Accurate When	Least Accurate When	Measurement Of	Network Overhead
ICMP Echo (Ping)	Target machine should be configured to respond to ICMP requests.	ICMP packets are handled with the same priority as UDP and TCP packets	When ICMP packets have low priority	ICMP echo request and echo response	Minimal
UDP	Network Capture agent installed on both Endpoints. UDP port must be allowed in the firewall.	Usually accurate; best choice for measuring VOIP behavior	When UDP packets have low priority	UDP transmission time	Minimal
TCP (peer-less)	Available only for peerless targets. Requires a TCP server listening to the selected port and that no TCP proxies are present on the path.	Usually accurate	Target machine runs Windows XP	TCP connection setup (TCP handshake)	Minimal
TCP (peer-based)	Used to measure TCP Response Time. Network Capture agent installed on both Endpoints. TCP port must be allowed in the firewall.	Windows 7 is the operating system	Jitter is very high (varies up to 3x from one packet to another); also when the Target machine is running MS Windows XP	TCP response time per data packet	Minimal

Metric	Requirements	Most Accurate When	Least Accurate When	Measurement Of	Network Overhead
HTTP Response Time	Requires HTTP server (e.g. web server) on target Endpoint.	HTTP Request/Response Roundtrip Time	Minor variance due to Server HTTP processing time; note that proxies and caches influence results	HTTP Response Time	Depends on the HTTP request chosen, usually minimal.
Unidirectional Estimate	Target Endpoint should respond to either NTP ICMP echo, or ICMP timestamp requests. UDP port allowed on firewalls between source and target.	Inbound link is available	Inbound link is congested and ICMP is chosen as the "pinging protocol"	Outbound available bandwidth	Substantial
Bidirectional estimate	Network Capture agent installed on both Endpoints. UDP port allowed on firewalls between source and target endpoints.	Not dependent upon other factors to increase accuracy	Traffic is bursty and has high throughput	Outbound and inbound available bandwidth	Moderate
Robust Bidirectional Sample	Network Capture agent installed on both Endpoints. TCP port allowed on the firewall.	Accurate when bandwidth is low (<50Mb) and roundtrip time is low (<120ms)	Traffic is bursty and has high throughput	Outbound and inbound available bandwidth	Substantial

Note:

TCP Packet Loss: When an acknowledgment of the TCP header is not received, retries are attempted to establish the connection, usually three to four times, depending upon the operating system.

A packet is defined as lost using the TCP protocol:

- If Network Capture detects that a retransmission has occurred.

HTTP Packet Loss:

Prior to measuring with the HTTP protocol, a connection between both Endpoints needs to be defined. Once established, a header request is sent.

Packets are considered to be lost in the following cases:

- No connection is established between monitor endpoints.
- Server response is not as defined by the user.
- The response time takes longer than the acceptable value defined by the user using the Timeout parameter.

Tips to Improve Measurement Accuracy

- When measuring Unidirectional Bandwidth to a specific Target Endpoint, avoid measuring additional bandwidth metrics to the same Target.
- To provide more accurate bandwidth measurements, avoid measuring both latency and bandwidth simultaneously especially if the Available Bandwidth is low. The reason for this recommendation is that peerless metrics (ICMP, TCP and HTTP) may take measurements simultaneously with the bandwidth probing, and may utilize some of the available bandwidth.
- For additional information about bandwidth measurements, see ["Defining the Interval for Concurrent Bandwidth Monitors" on page 33](#).

Installation and Upgrade

HP's Network Capture records actual network conditions and enables the import and recreation of network environments into pre-production and testing labs. This data is used to accurately assess and analyze the performance of distributed applications using the HP Network Virtualization network appliance and desktop applications.

This section describes how to install, upgrade, and license the product, including:

• Installing Network Capture	12
• Reverting an Installation	21
• Upgrade Compatibility	22
• Log and Configuration Files	23
• Login	24
• Licensing Network Capture	24
• Changing between Secure and Non-Secure Communication Post Installation	26

Installing Network Capture

The Network Capture Server installer installs the Server, Web Server and Agent components. To conduct peer-based probing, the Network Capture Agent must also be installed on the Target machine. To install Network Capture components, you must have Windows™ Local Administrator permissions.

Note: Certain installation errors may be displayed in the MS Windows Installer logs and not in the Network Capture logs. For more information, see "[Log and Configuration Files](#)" on page 23.

• System Requirements and Resource Utilization	13
• Secure Communication in Network Capture	14
• Network Capture Server Installation	16
• Network Capture Agent Installation	18
• Firewall Configuration	19

System Requirements and Resource Utilization

System Requirements can vary according to the usage on the specific Server and Agent machine.

Three levels of usage are defined for the Agent:

- **Light:** Agent, either a Source or a Target, is involved in up to 5 concurrently running monitors
- **Medium:** Agent, either a Source or a Target, is involved in up to 10 concurrently running monitors
- **Heavy:** Agent, either a Source or a Target, is involved in up to 25 concurrently running monitors

Note: Since an Agent is always installed on the Server machine as part of the Server installation, consider the Agent requirements when determining the system requirements.

Network Capture Server System Requirements

The minimum requirements for Network Capture Server (including the Web Server component) are:

Processor	1.3 GHz (32 bit or 64 bit)
Memory	2 GB RAM
Free Hard Disk Space	100 GB of free disk space (includes space for recordings)
Network Adapter	Network Interface Card, WIFI, Cellular Cards or Virtual NICs
Browser	<ul style="list-style-type: none"> • Internet Explorer 7.0 or higher • FireFox 4.0 or higher <p>Note: Supported screen resolution is 1280x800 and higher with a zoom level of 100%.</p>
Operating Systems (English versions only)	<p>Microsoft Windows:</p> <ul style="list-style-type: none"> • Server 2003 SP2 (32/64bit) • Server 2003 R2 SP2 (32/64bit) • Server 2008 SP2 (32/64-bit) • Server 2008 R2 (64 bit) • Server 2008 R2 Hyper-V (64-bit) • Windows 8.1 (32/64-bit) • Windows 2012 R2 (64-bit)
Remote Access	Microsoft RDP for supported operating systems
Virtualization	VMware ESXi 4.0 Windows 2008 HyperV (64 bit) VMware Workstation 6.0 and higher

Network Capture Agent System Requirements

The requirements for the Network Capture Agent are:

Processor	<ul style="list-style-type: none"> • Light usage: 1.3 GHz (32 bit or 64 bit) • Medium usage: 2 GHz (32 or 64 bit) • Heavy: 3 GHz Dual-Core (32 or 64 bit)
Memory	<ul style="list-style-type: none"> • Light usage: 1 GB RAM

Installation and Upgrade

	<ul style="list-style-type: none"> • Medium usage: 2 GB RAM • Heavy usage: 4 GB RAM
Free Hard Disk Space	1 GB of free disk space
Network Adapter	Ethernet or Network Interface Card, WIFI, Cellular Cards, Virtual NICs
Virtualization	<ul style="list-style-type: none"> • VMware ESXi 4.0 • Windows 2008 HyperV (64 bit) • VMware Workstation 6.0 or higher
Network Capture Agent (standalone) English versions only	Microsoft Windows: <ul style="list-style-type: none"> • Server 2008 SP2 (32/ 64 bit) • Server 2008 R2 (64 bit) • Windows 7 (32/64 bit) *
*Light and medium usage only	

Resource Utilization with Heavy Usage

	Agent CPU	Server CPU	Agent Memory
Windows Server 2008 32 Core 2 Duo E7500 3 GHz 4 GB RAM	30%	7%	1 GB
Windows 7 Enterprise Core 2 Duo E7500 3 GHz 4 GB RAM	30%	-	1 GB

Secure Communication in Network Capture

Encrypted communication is supported on Network Capture:

- from the Client (browser) to the Web Server component
- from the Web Server component to the Server
- from the Agent to the Server

Encrypted communication is not supported on Network Capture:

- from an Agent to any other Agent, including the local Agent installed on the Server machine.

Enabling secure communication on the Network Capture Server creates a self-signed certificate on the Server machine.

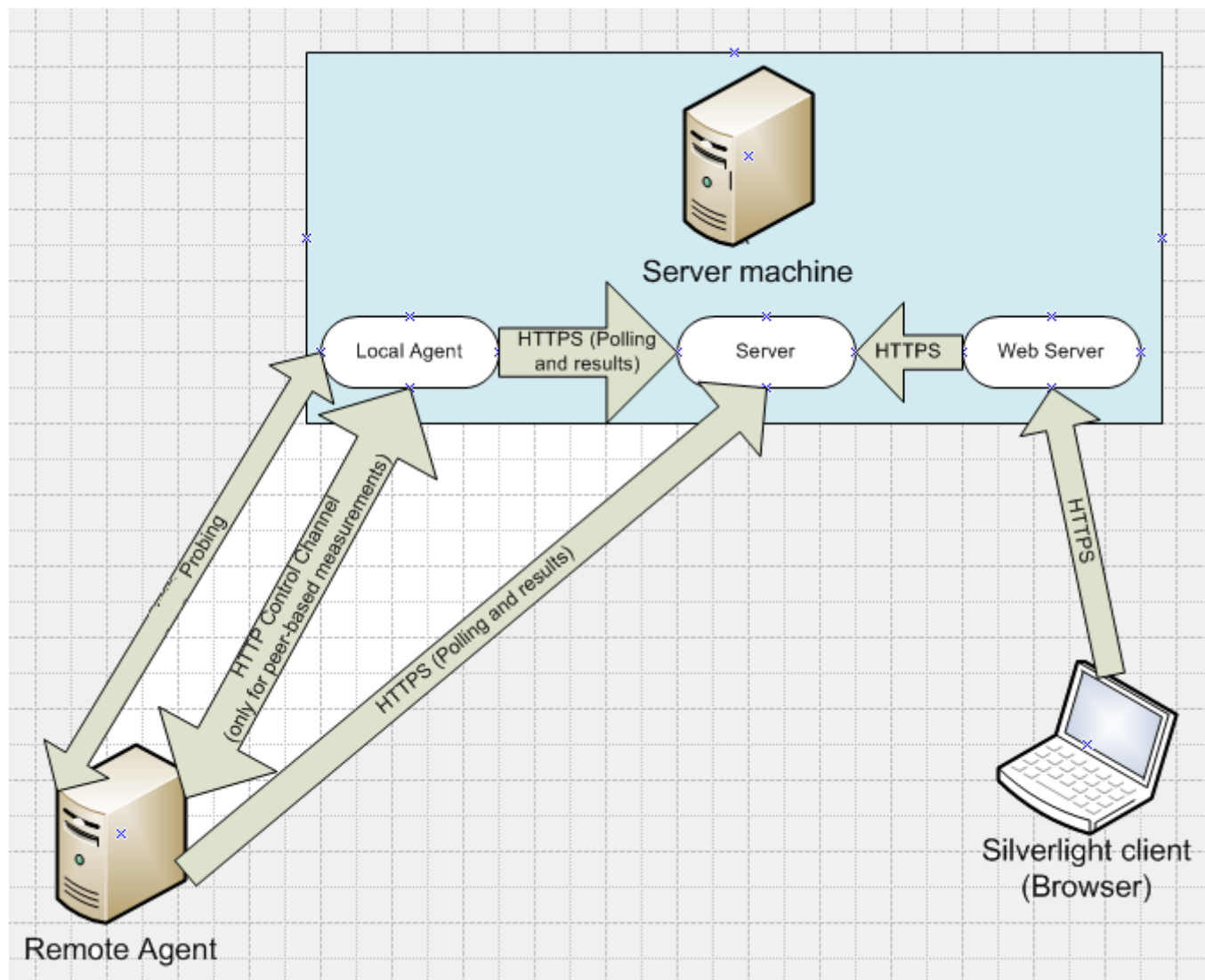
Note: Neither Clients nor Agents have any means to validate the Server certificate used during the secure connection to the Server. Therefore:

- A security warning is displayed when a user logs on to the Network Capture UI. This warning is presented by the web browser, because the browser does not recognize the Server certificate.
- Agents log a warning message containing the certificate information and then silently accept it.

Consequently, although the established connection is using HTTPS, it is vulnerable to the man-in-the-middle attack.

Installation and Upgrade

The diagram shows the secure and non-secure channels, when secure communication is enabled on the Server and Agent.



Note: Firewall rules must be defined for each "arrow" in the diagram. For details, see ["Firewall Configuration" on page 19](#).

For example, in a configuration where:

- The Remote Network Capture Agent is listening on port 80
- The Network Capture Server is listening on port 443
- The Local Network Capture Agent is listening on port 90
- A Monitor is configured with the Local Agent as the Source and the Remote Agent as the Destination, and it measures latency using the TCP Protocol on port 997 (default port).

The following channels use the following ports:

- Source and Destination Agents use secured communication via port 443 to publish themselves and poll; the Source sends results back to the Server.
- The Destination Agent contacts the Source via the non-secured control channel using port 90 if the Destination Agent restarts or undergoes a crash recovery.
- Source Agent connects to the Destination Agent via the non-secured control channel on port 80.
- Source Agent probes for latency using non-secured communication on port 997.

Network Capture Server Installation

The Network Capture Server installer also installs the Network Capture Web Server and a local Network Capture Agent.

Prerequisites

- **IIS** (must be installed prior to installation of the Network Capture Server). For IIS 7.0, ensure that IIS 6.0 Metabase Compatibility is enabled.

Note: Windows 8.1 and Windows 2012 R2 require the following settings:

- Web Server > Common HTTP Features > Static Content
- Web Server > Performance > Static and Dynamic Content Compression
- .NET Framework 4.5 Features > WCF Services > HTTP and TCP Activation

- **MySQL** Standard Edition or higher, that includes:
 - MySQL Server, version 5.1 or higher

Note:

- MySQL Server versions 5.5.42 and 5.5.43 are not supported.
- The latest tested MySQL Server version is 5.6.24.

- MySQL Connector/NET, version 6.8.3 or higher

Note: MySQL configuration such as port settings, the 'root' user password and database connection type should not be altered after completing the Network Capture installation. If MySQL configuration changes are required, contact support at <https://softwaresupport.hp.com/>.

- **WinPcap** 4.1.2 or higher <https://www.winpcap.org/install/default>

Note: For Windows 8.1 and Windows 2012 R2, use WinPcap 4.1.3 or higher.

The following components will be installed as part of the installation if they are not already installed on your machine:

- Microsoft .NET Framework 4.0 Full
- Microsoft Visual C++ 2005 SP1 Redistributable Package
- Dynamic IIS Content Compression (highly recommended to enhance performance and reduce the load on network resources; may utilize additional machine resources)

To install the Network Capture Server:

1. As the Administrator, run **NC.Server.Setup.exe** and follow the instructions in the wizard. If required, a customized port can be selected during the installation process. During the installation, you can change the Network Capture Server and the local Agent port number. This may be required, if another application (such as Skype) is using the default port.

Note: IP Addresses are not recommended if dynamic IP Addresses are used, as they can change when the machine is rebooted; use the hostname, URL or FQDN.

Note: If the Server machine is behind NAT, only the external address should be defined; do not use the internal host name or IP as the Server address. For the local Agent that is installed with the Server, see ["Network Capture Agent Installation" on the next page](#).

Configure the NAT device to enable port forwarding of the Network Capture Server port defined during installation (80\443 or user-defined).

2. Restart the host machine when the installation completes.
3. Ensure that the Network Capture Server and Agent Services are up and running.

Enabling Secure Communication (HTTPS) on the Server

Secure Communication (HTTPS) is enabled on the Network Capture Server as part of the installation wizard; make sure to select the **HTTPS** option.

Note: If you enable HTTPS on a non-default port, you must perform the following steps after installation.

In IIS Manager, in the Site Bindings dialog box, add an additional binding for the IIS Default Web Site using the following parameters:

- Type: https
- IP Address: All Unassigned
- Port: <your custom port>
- SSL certificate: <select the certificate created by Network Capture>

You can also enable secure communication at any time post-installation. For details, see ["Changing between Secure and Non-Secure Communication Post Installation" on page 26](#).

For additional details regarding secure communication components, see ["Secure Communication in Network Capture" on page 14](#).

Uninstalling Network Capture Components

Remove all three components separately:

- Network Capture Web Server
- Network Capture Agent
- Network Capture Server

To uninstall the Network Capture Server Components:

1. Login to the UI and stop all running monitors.
2. Back up recording files, by default in C:\Program Files\HP\NetworkCapture\CatcherFiles, to another place on your hard drive, or another location.
3. As the Administrator, in the Control Panel double-click the **Add/Remove programs** icon, select the HP Network Capture component, and click the **Change/Remove** button. Follow the on-screen instructions.

OR

Run **NC.<component>.Setup.exe** and select **Remove**; follow the instructions in the wizard.

During the uninstall, you will have the option to retain your database for future use. Ensure that you know your MySQL 'root' user password.

Restart the host machine when the uninstallation of all components completes.

Network Capture Agent Installation

For all types of measurements, the Network Capture Agent must be installed on the Source Endpoint. In addition, bidirectional bandwidth and other peer-based measurements require an Agent at the Target Endpoint. For details, see ["FAQs and Troubleshooting" on page 49](#).

Installing the Network Capture Agent

Prerequisites

- WinPcap 4.1.2 or higher

Note: For Windows 8.1 and Windows 2012 R2, use WinPcap 4.1.3 or higher.

The following components will be installed as part of the installation if they are not already installed on your machine:

- Microsoft .NET Framework 4.0 Full
- Microsoft Visual C++ 2005 SP1 Redistributable Package

To install the Network Capture Agent:

Login to the Network Capture user interface. From the Options menu select **Download Agent** and download the **NC.Agent.Setup.exe** file. This file is also available in the installation package.

Note: In the browser, make sure to allow Popup windows and the 'Download Files' option is enabled in the browser Security Settings.

As an administrator, run **NC.Agent.Setup.exe** file and follow the instructions in the wizard. During the installation, you can change the Network Capture Agent port number. This may be required, if another application (such as Skype) is using the default port. If Server is configured for secure communication, make sure to select the **Secure Connection (HTTPS)** option. Secure communication may be enabled at any time post-installation. For details, see ["Installing the Network Capture Agent" above](#).

For additional details regarding secure communication components, see ["Secure Communication in Network Capture" on page 14](#).

Note:

- IP Addresses are not recommended if dynamic IP Addresses are used, as they can change when the machine is rebooted; use the hostname, URL or FQDN.
- During installation of the Network Capture Agent, when specifying the Network Capture Server address and port, ensure that you enter the Network Capture Server details in the same format as you have entered it in the Network Capture Server installation.

For example, if you entered the host name during the Network Capture Server installation, use the same host name, not the IP address, during the Network Capture Agent installation.

- If the Network Capture Agent is behind NAT and is required to communicate with other Source or Target Agents that are not behind the same NAT, both the internal and external addresses must be provided. Configure the NAT device to enable port forwarding of the Network Capture Agent's port, defined during the installation (80 or user-defined), and in addition, enable port forwarding of any metrics' ports that are used by the Monitors. For details, see port specifications in ["Firewall Configuration" below](#).

Uninstalling the Network Capture Agent

To uninstall the Network Capture Agent:

1. Login to the UI and stop all running monitors.
 2. Backup the file **NC.Agent.Host.exe.GUID** (this file may not be present in every configuration), by default located in \<AgentRootFolder>\Bin.
 3. As the Administrator, in the Control Panel, double-click the **Add/Remove Programs icon**, select **HP Network Capture Agent**, and click the **Change/Remove button**. Follow the on-screen instructions.
- Or**
- Run **NC.Agent.Setup.exe** and select **Remove**; follow the instructions in the wizard.
4. When reinstalling or upgrading, replace the file **NC.Agent.Host.exe.GUID** with the original file that was backed up.
 5. Restart the host machine when the installation completes.
 6. When reinstalling or upgrading:
 - a. Login to the Network Capture UI.
 - b. In the Endpoint page's toolbar, click **Scan All Endpoints Availability**. Two Endpoints with the same address are displayed; delete the Endpoint with the Status of Unreachable one (red icon).

Firewall Configuration

Ensure that ports required for Network Capture internal communications and monitoring are not blocked by any firewalls.

Network Capture Server

The following ports are generally involved:

- 443 for secure communication (may vary, depending upon the operating system)
- 80 for non-secure communication (may vary, depending upon the operating system)

Note: Since the Network Capture Server also includes a local Agent, make sure to configure the required Agent ports on the firewall as described in the following sections.

Network Capture Source Agents

For communication with the Network Capture Server:

- Outbound TCP port 80\443 (or another TCP port defined during Network Capture Server installation)

For communication with the Network Capture Target Agent:

- Outbound TCP port 80 (or another TCP port defined during Network Capture Target Agent installation)

For the following metrics:

- **TCP peerless:** outbound TCP 80 (or another user-configurable port)
- **TCP peer based:** outbound TCP 997 (or another user-configurable port)
- **UDP:** outbound UDP 997 (or another user-configurable port)
- **Unidirectional Estimate:**
 - Outbound UDP 53 (or another user-configurable probing port)
 - Outbound ICMP timestamp or ICMP Echo reply (according to selected Pinging Protocol)
- **Bidirectional Estimate:** outbound UDP 998 (or another user-configurable port)
- **Robust Bidirectional Sample:** outbound TCP 995 (or another user-configurable port)

Target Agent Based Endpoints

For the communication with Network Capture Source Agent:

- Inbound TCP port 80 (or another user-configurable TCP port) is open

For the following metrics:

- **ICMP metric:** ICMP Echo reply
- **TCP peerless:** inbound TCP 80 (or another user-configurable TCP port)
- **TCP peer based:** inbound TCP 997 (or another user-configurable TCP port)
- **UDP:** inbound UDP 997 (or another user-configurable port)
- **Unidirectional Estimate:**
 - Inbound UDP 53 (or another user-configurable probing port)
 - Inbound ICMP timestamp or ICMP Echo reply (according to selected Pinging Protocol)
- **Timestamp\ICMP Echo reply\Inbound UDP:** 123 according to the selected pinging protocol
- **Bidirectional Estimate:** inbound UDP 998 (or another user-configurable port)
- **Robust Bidirectional Sample:** inbound TCP 995 (or another user-configurable port)

Target Agent Less Endpoints

For the following metrics:

- **ICMP:** ICMP Echo reply.
- **TCP peerless:** (inbound TCP 80\customized)
- **Unidirectional Estimate:**
 - Inbound UDP 53 (or another user-configurable probing port)
 - Inbound ICMP timestamp or ICMP Echo reply (according to selected Pinging Protocol)

Reverting an Installation

When an install is aborted, the Network Capture installation provides two ways of reverting a PC to its previous state.

Installation rollback

- Rollback is an integrated feature. No user interaction is needed to trigger it.
- Rollback Actions are triggered when the setup encounters an abort (automatic failure or manual cancellation).
- Modifications performed by the setup program are reversed.
 - Installed files will be removed.
 - Shortcuts or registry entries added will also be removed.
 - New directories created by the install and log files will NOT be removed.

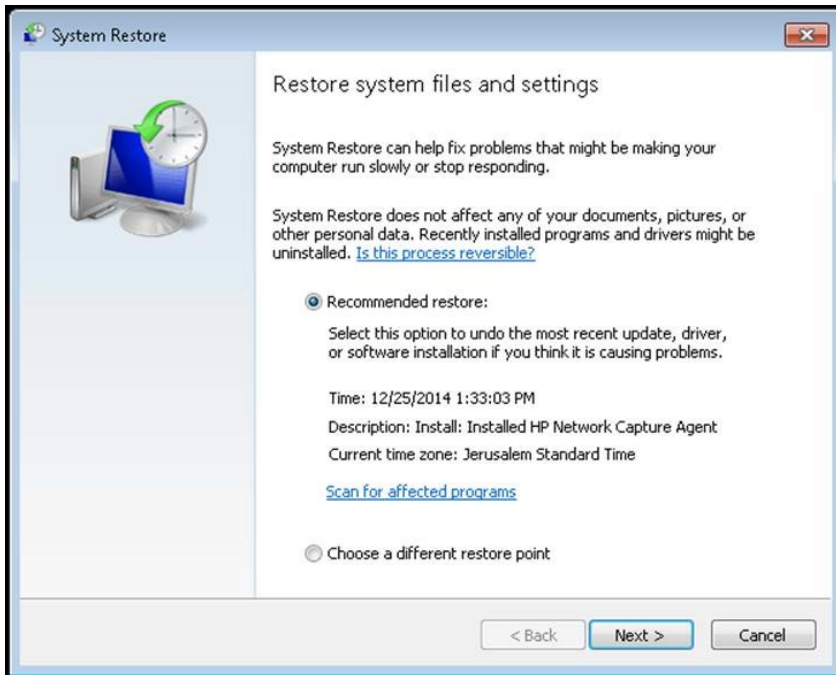
System Restore Point

If your PC has become corrupt during the software install, you may run System Restore, which is a native Windows feature. This feature automatically monitors and records key system changes to your PC. The Network Capture installation supports System Restore by setting multiple system restore points, including before starting the file transfer; you may then use the System Restore wizard to restore the system to its latest successful restore point. Or you may choose a different restore point manually.

Note: Not all Windows versions utilize System Restore.

- Supported versions include (but are not limited to): Windows XP, Windows 7, Windows8
- Unsupported versions include (but are not limited to): Windows Server 2008

To initiate system restore go to Start -> System Restore.



Upgrade Compatibility

Upgrading from Network Capture v6.0 or v7.0 to v7.11

Note: Previous versions of HP Network Capture were formerly Shunra NetworkCatcher v6.0 or v7.0.

To upgrade the Network Capture Server:

Note: When upgrading from a previous version of HP Network Capture to Network Capture v7.11 all Agents must be given the Name and Address in the exact format with the same values that were defined in v6.0 or v7.0.

1. Backup the MySQL 'NC' and 'Security' databases to ensure that you can access the original data if required. By default, the database is located in:
 - On Win 2003: C:\Documents and Settings\All Users\Application Data\MySQL\MySQL Server 5.1\Data
 - On Win 2008, Win 8.1, and Win 2012 R2: C:\ProgramData\MySQL\MySQL Server 5.1\data
2. Log in to Network Capture and stop all running monitors.
3. Uninstall all Network Capture components, refer to "[Uninstalling Network Capture Components](#)" on [page 17](#).
4. Install the Network Capture Server v7.11. For details, see "[Installing Network Capture](#)" on [page 12](#). Ensure that you install the Network Capture Server in the original installation path, to avoid difficulties with licensing.

Note: If the existing database is very large, the install may be a time-consuming process. To

avoid data corruption, do not interrupt the install procedure.

5. Restart the host computer.

Upgrading the Remote Agent

1. Backup the file **NC.Agent.Host.exe.GUID** (when upgrading from v7.0), by default located in **\<AgentRootFolder>\Bin**.
2. Uninstall the Network Capture Agent, refer to ["Uninstalling the Network Capture Agent" on page 19](#).
3. Login to the newly installed Network Capture user interface; from the Options menu select **Download Agent** and download the **NC.Agent.Setup.exe** file. This file is also available in the installation package.
4. Install the Network Capture Agent. For details, see ["Installing the Network Capture Agent" on page 18](#).
5. Replace the file **NC.Agent.Host.exe.GUID** with the original file that was backed up (when upgrading from v7.0).
6. Login to the Network Capture UI.
7. In the Endpoint page's toolbar, click **Scan All Endpoints Availability**. Two Endpoints with the same address are displayed; delete the Endpoint with the Status of 'Unreachable' (red icon).

Log and Configuration Files

By default, the logging level is 'Info' which just notes the problem without any explanation. You can adjust the level to 'Error' or other choices in the configuration file per component.

Configuration Files

The configuration files in which you can change the logging levels are found by default in:

- **Server:** **NC.Server.Host.exe.config** (in ...\\HP\\Network Capture\\Server\\Bin)
- **Agent:** **NC.Agent.Host.exe.config** (in ...\\HP\\Network Capture\\Agent\\Bin)
- **Web Server:** **web.config** (in ...\\HP\\Network Capture\\Web Server\\)

Log Files

The supported log levels are (from the most to the least detailed):

- **DEBUG:** highly detailed information, that logs each database operation; slows down the Server considerably
- **INFO:** provides information that is usually sufficient to troubleshoot ordinary issues
- **WARN:** warnings only
- **ERROR:** indicates the origin of a problem origin, usually does not contain sufficient information for troubleshooting

Log files are located by default in 64 bit systems in this folder:

- C:\Program Files (x86)\HP\Network Capture\Server (or Agent or Web Server)\Logs

Log files are located by default in 32 bit systems in this folder:

- C:\Program Files\HP\Network Capture\Server (or Agent or Web Server)\Logs

Log files overwrite previous files once the allotted memory has been exceeded.

Logs in the MS Windows Installer

Certain installation errors may be displayed in the MS Windows Installer logs and not in the Network Capture logs. These logs are usually only required when troubleshooting is necessary:

- The setup logs are located in the \%Temp% folder
- Windows Installer logs are not generated by default. To view these logs in the \%Temp% folder, this key should be added to the Registry prior to installation:

[HKEY_LOCAL_MACHINE\SOFTWARE\Policies\Microsoft\Windows\Installer] "Logging"="voicewarmupx"

Login

Once the Network Capture Server is installed, in your browser navigate to: **http(s)://<Network Capture Server address>/network_capture**

Use **Administrator/Administrator** as the user name and password, then change the username and/or password to restrict access.

Note: Microsoft Silverlight will be installed when opening the Network Capture user interface the first time. The first login may take a few minutes until the content is transferred from the Web Server component.

Licensing Network Capture

The Network Capture **Trial License** provides:

- Up to 10 concurrently running monitors
- Up to 100 endpoints
- 30 days usage; each run can record for up to 7 days

The Network Capture **Standard License** provides:

- Up to 25 concurrently running monitors
- Up to 100 endpoints
- Analysis
- Scheduling
- Export
- Can be used indefinitely; each run can record for up to 31 days

Requesting and Installing a License Key

After the trial license expires, you will have to obtain a license by sending your Host ID to HP, where it is used to generate the License Key. The License Key is sent back to you by email within 1 business day, and you enter it in the Network Capture License Manager.

Installation and Upgrade

To request a License Key:

1. Login to the Network Capture UI as a Network Capture Administrator.
2. From the toolbar, click **Options > License manager**.

HP Network Capture License Manager

Obtain License

Host ID: 3DF6 4BB5 E438 99CD 3C
Press Ctrl+c to copy

License Key: Enter License Key here
Press Ctrl+v to paste

Activate

License: Professional
Expiration Date: 8/30/2015 12:00:00 AM

Features	Status
Maximum Concurrent Measurements	25
Maximum Endpoints	100
Export to NTX	Enabled
Enable Analysis	Enabled
Monitor Scheduling	Enabled

Close

3. Record the Host ID.
4. Access the HP Licensing site (<http://www.hp.com/software/licensing>) and do one of the following:
 - If you have a valid license Entitlement Order Number (EON), enter your EON to activate your license.
 - To obtain a new license, click Contact HP Licensing to locate a Regional Licensing Support Center.

Your license activation request will be routed to the HP licensing team for processing. The licensing team will contact you to request the Host ID of your Network Capture machine.

To install a License:

1. As a Network Capture Administrator, from the toolbar, click **Options > License manager**.
2. In the License Key text field, enter the License Key provided to you by HP; the Activate button becomes active.
3. Click **Activate**, then click **Close**.

Changing between Secure and Non-Secure Communication Post Installation

This section includes:

- [Enabling Secure Communications](#)27
- [Disabling Secure Communications](#)28

Enabling Secure Communications

To enable secure communication on the Network Capture Server:

1. In the Network Capture UI, stop all running monitors.

Note: "IIS 6 Metabase Compatibility", an IIS role service must be installed.

2. Open a command window (Start > Run > CMD).
3. Change directory to <Server root directory>\bin directory, and run:
SimpleNCServerSecurity.exe -m=all -s -p=<customized port (default is 443)>

Note:

- It is recommended to first run this command as a 'trial run' before executing the configuration as follows:
SimpleNCServerSecurity.exe -m=all -s -p=<customized port/default is 443> -n
Ensure that no errors are present in the output window.
- If you enable HTTPS on a non-default port, you must perform the following steps after installation.
In IIS Manager, in the Site Bindings dialog box, add an additional binding for the IIS Default Web Site using the following parameters :
Type: https
IP Address: All Unassigned
Port: <your custom port>
SSL certificate: <select the certificate created by Network Capture>

4. Restart the HP Network Capture Server service.
5. To change the local Agent mode, see the following section.

To enable secure communication on the Agent:

1. Login to the UI and stop all running monitors.
2. Uninstall the Network Capture Agent. For details, see "[Uninstalling the Network Capture Agent](#)" on [page 19](#).
3. Install the Agent according to "[Installing the Network Capture Agent](#)" on [page 18](#) and select the **Secure communication** checkbox.

Note: It is possible to enable secure communication on the Agent without reinstalling the Agent; however, it involves manual configuration of system files and may result in corrupted data. Therefore, before attempting this procedure, backup any Network Capture Agent files that will be modified. For instructions about how to conduct this procedure, contact support at <https://softwaresupport.hp.com/>.

4. Restart the Network Capture Agent Service.

Disabling Secure Communications

To disable secure communication on the Server:

1. In the Network Capture UI, stop all running monitors.
2. Open a command window (Start > Run > CMD).
3. Change directory to <Server root directory>\bin directory, and run:

```
SimpleNCServerSecurity.exe -m=all -p=<customized port/default is 80>
```

Note: It is recommended to first run this command as a 'trial run' before executing the configuration as follows:

```
SimpleNCServerSecurity.exe -m=all -p=<customized port/default is 80> -n
```

Ensure that no errors are present in the output window.

4. Restart the HP Network Capture service.
5. To change the local Agent mode, see the following section.

To disable secure Communication (HTTPS) on the Agent:

1. Login to the UI and stop all running monitors.
2. Uninstall the Network Capture Agent. For details, see "[Uninstalling the Network Capture Agent](#)" on [page 19](#).
3. Install the Agent according to "[Installing the Network Capture Agent](#)" on [page 18](#) and do not select the **Secure communication** checkbox.

Note: Secure communication on the Agent can be disabled without reinstalling the Agent; however, this involves manual configuration of system files and may result in corrupted data. Therefore, before attempting this procedure, backup any Network Capture Agent files that may be modified. For instructions about how to conduct this procedure, contact support at <https://softwaresupport.hp.com/>.

4. Restart the Network Capture Agent Service.

For additional details regarding secure communication components, "[Secure Communication in Network Capture](#)" on [page 14](#).

Using Network Capture

HP's Network Capture monitors network conditions by sending and receiving data packets between one or more destinations. In addition, create Network Profiles to provide network conditions for specific networks. For an overview, see ["HP Network Capture " on page 6](#).

Let's get started with HP's Network Capture and find out how to record, analyze and export network conditions, including:

• Moving Around	30
• Creating Endpoints	30
• Configuring a Monitor	32
• Start Monitoring	38
• Viewing Data	38
• Analyzing Data	44
• Using Network Profiles	45
• Exporting Data	46
• Defining and Updating Users	47
• Setting Schedules	49
• FAQs and Troubleshooting	49
• Obtaining Technical Support	53

Moving Around

It is recommend that the screen resolution be set to 1280 x 800 (or higher) with zoom level of 100%. The Network Capture interface can only be viewed in the 32-bit browsers.

Network Capture provides a number of ways to customize how you view and input information:

- To select items, click on them, for example, when viewing Results of a Monitor, click **ICMP** to view the ICMP results, or click again to hide the results.
- Choose to display monitors and results in either Tree or List view, with or without the Map.
- View the details about a particular Endpoint, Monitor, Profile or User, by selecting the Tree or Grid icon.

Drag And Drop

In the "Monitors" and "Profiles" view, you can add folders drag and drop folders and subfolders within the tree.

Map View

You can display or hide the map when you are configuring Monitors or Endpoints, by clicking the **map** icon.

Save

When you leave an item, such as a Monitor, your additions and updates are automatically saved. In addition, you can manually save any modifications by selecting the **Save** button.

Undo

To cancel any modifications, select the **Undo** button, which reverts the data to the previously saved data.

Refresh All

Use **Refresh All** to display the most updated data from the Network Capture Server in the user interface. The UI is updated automatically every 15 minutes.

Creating Endpoints

An Endpoint represents a network node at a given address. Within a monitor, an Endpoint is either the Source Endpoint (the location from which you are measuring) or the Target (the destination to which you are measuring). Endpoints can be defined as a Data Center, Web Server, Application Server, Network Element, etc. The Source Endpoint must have a Network Capture Agent installed; on the Target Endpoint it is only required for certain metrics.

Once an Agent is installed on a machine, it will appear in the UI as an Endpoint; therefore **it is recommended not to create an Endpoint before installing the Agent.**

To create an endpoint manually (not recommended):

1. As Administrator, from the Monitors page, select **Endpoints**.
2. Click the **New Endpoint** icon, then type:
 - Name: up to 100 alpha-numeric characters
 - Address: the machine's address; it can be a host name, FQDN, IP, or URL of up to 255 characters.

Note:

- If the Endpoint is behind NAT, provide the address of the NAT device behind which the Endpoint is located and configure the Internal Address using the Advanced Settings icon. It represents the Endpoint's machine address, it can be a Host name or FQDN of up to 255 characters.
- If, when initializing a Monitor, the Server does not recognize the Source Agent, this may be due to issues with DNS Resolution. Since the Server must be able to recognize the Source Agent, use one of the following:
 - Fully-Qualified Domain Name, such as "server1.company.com" (To verify this property, right-click the **My Computer** icon, select **Properties** and scroll to the **Full Computer Name**)
 - IP Addresses are not recommended if dynamic IP Addresses are used, as they can change when the machine is rebooted
- Type: select one of the categories such as **Data Center, Remote Office, etc.**; the location on the map displays the icon of the selected Type
- Description: provide relevant details that identify the endpoint (optional) up to 255 characters
- HP Agent Installed: select if the Network Capture Agent is to be installed at this location; mandatory for Source Endpoints

Note: If you define an Endpoint prior to installing it, during the installation of the Agent, make sure to enter the Agent address and name as you defined it when creating an Endpoint in the Network Capture UI.

To edit an Endpoint:



In the list of Endpoints, select an Endpoint, then edit the details. The modified data can be saved manually, or is saved automatically when you leave the modified Endpoint.



To delete an Endpoint:

Select the Endpoint you wish to delete and click the **Delete** icon.

Note: Endpoints cannot be deleted and Endpoint addresses cannot be edited when they are used in existing monitors.

Endpoint statuses

	Unresolved: the Endpoint was added in UI before it was installed on a host machine
	Reachable: the Agent can poll the Network Capture Server and obtain commands

	Unreachable: the Agent cannot poll and receive commands from the Server
	Agentless: An agent has not been installed and configured

The status of the Endpoint is updated approximately every 5 minutes; the green icon indicates that it is reachable and able to access the Network Capture Server.

Note: Although both peerless and peer-based Endpoints can be defined on the same machine, this may reduce the accuracy of concurrent measurements. For more information, see ["Tips to Improve Measurement Accuracy" on page 10](#).

Configuring a Monitor

You can run up to 25 monitors simultaneously (license dependent).

- [Adding and Deleting Monitor Folders](#) 32
- [Defining the Interval for Concurrent Bandwidth Monitors](#) 33
- [Configuring Latency and Packet Loss](#) 34
- [Configuring Bandwidth](#) 36
- [Configuring Web Server Parameters](#) 37

Adding and Deleting Monitor Folders

The Tree view contains the "Monitors" root folder. You can add folders and subfolders to this or any other folder, and also drag and drop folders within the tree. Folder names can be up to 255 characters.

To add a folder:

Click the **New Folder** icon and provide the relevant details.

To add subfolders:

Select the parent folder and click the **New Folder** icon and provide the relevant details.

To delete a folder:

As long as the folder or its subfolders do not have any active runs, select the folder and select the **Delete** icon in the toolbar or the keyboard **Delete** button.

To configure a monitor:

1. In the Monitors view, click the **New Monitor** icon.
2. Define the following:
 - **Name:** Type a name, up to 100 alphanumeric characters.
 - **Source:** Select an endpoint (only those endpoints that have an Agent installed are visible).
 - **Target:** Select an endpoint from the list.
 - **Duration:** Scroll or use the arrows to set the time period for the recording.

- For Latency and Bandwidth settings, select the checkbox beside the required metric. To adjust the settings, click the **Settings** button beside the metric. For more information, see ["Configuring Latency and Packet Loss" on the next page](#) and ["Configuring Bandwidth" on page 36](#).
 - **Description:** optional (up to 255 characters).
3. Click **Save** (or will be saved automatically when you leave Monitor). The parameters are validated during the 'Save' operation.
 4. To begin measuring, click the **Run Monitor** icon.

Note: If the following metrics are measuring to the same Target Agent, even if they are not in the same monitor, they should not be configured to use the same port:

Robust Bidirectional Sample Bandwidth and

- TCP (peer-based)
- TCP (peerless)
- HTTP

TCP (peer-based) and

- TCP (peerless)
- HTTP

To delete a monitor:

Click the **Delete Monitor** icon in the toolbar when the Monitor is not running.

To delete a run:

Click the **Delete Run** (trash can) icon in the Results view.

Defining the Interval for Concurrent Bandwidth Monitors

Peerless Bandwidth measurements block the Source Agent, and peer-based bandwidth metrics block both the Source and Target Agents from conducting other measurements while they probe.

This causes a delay in the execution of any other monitor the Agent has queued. To avoid congestion, the Agent redefines the Bandwidth Interval setting of its active monitors, keeping a ratio of 75% latency and packet loss to 25% bandwidth.

This ratio determines the calculation of the 'Time Window' which correlates to the bandwidth interval. The Time Window is determined by the types and number of bandwidth metrics to and from a specific Agent. The probing time of Unidirectional Bandwidth takes about 20 seconds. Therefore, if the same Agent is a Source for three Unidirectional Bandwidth Monitors that are defined to measure every 20 seconds, for any given minute no other measurements will occur. To prevent this situation, the actual Bandwidth Interval for each Source Agent is defined as:

Interval = No x TW

Each bandwidth metric uses a different coefficient (C) to calculate the Time Window (TW).

Where:

No=Number of outgoing bandwidth measurements from the specific Agent

TW (Time Window) = $C \times (N_i + 1)$

C=80 for Unidirectional Bandwidth

C=20 for Bidirectional Bandwidth

C=120 for Robust Bidirectional

N_i=number of incoming bandwidth measurements to the specific Agent

For the example above with three Unidirectional Bandwidth monitors, the Time Window will equal 80 seconds (20 seconds for bandwidth probing and 60 seconds for latency and packet loss measurements. Each bandwidth monitor will have an Interval of 240 seconds.

Note: The Time Window is calculated per Agent, and the maximal value determines the Time Window for all running Monitors.

To reduce the actual probing interval (time between probing samples) the following are recommended:

- Use the default bandwidth metric (Bidirectional Bandwidth).
- Avoid running multiple monitors to and from the same Agent. Instead, either spread the Monitors between more Agents, or have the Monitors run one after the other.

Note: Installing several agents in the same location could create conflicts if they use the same physical link.

Configuring Latency and Packet Loss

To measure the latency and packet loss, select one of the following probing metrics:

- ["TCP \(Peer-based\)" below](#)
- ["TCP \(Peerless\)" on the next page](#)
- ["UDP" on the next page](#)
- ["ICMP" on the next page](#)

TCP (Peer-based)

The Source Endpoint sends packets via a TCP connection to the Peer, and measures the TCP response time. Less accurate results are obtained when high jitter is present.

- **Interval:** Select a value or use the default of 5 seconds.
- **Packet Size:** The packet size to be used when probing (in bytes).
- **Peer Port:** Type the number of an available port on which no server is listening, or use **Auto Select** to scan a predefined list of ports and to locate an available port.

Note: Due to an issue in MS Windows XP's implementation of the TCP/IP stack, TCP Available Bandwidth may measure inaccurate packet loss rates. If possible, avoid Monitors that use TCP when the endpoint's operating system is Windows XP. If only one endpoint machine runs XP, it is preferable that this endpoint be the Target.

TCP (Peerless)

Measures the time it takes to establish a new TCP session (sending a SYN packet and receiving a SYN ACK packet). For network measurement, using agent-less TCP, a TCP/HTTP server is required on the Target Endpoint.

Note: If a network accelerator or a proxy service is in the network path, the network measurements may not be accurate, as the accelerator or proxy may respond to the request instead of the required server.

- **Interval:** Select a value or use the default of 3 seconds
- **Peer Port:** Type the port number for the port that connects to the Target server.
- **Include DNS Resolution:** Select to include the domain name IP address resolution as part of the measurement.

Note: Due to an issue in MS Windows XP's implementation of the TCP/IP stack, TCP may measure inaccurate packet loss rates. If possible, avoid Monitors that measure using TCP when the endpoint's operating system is Windows XP. If only one endpoint machine runs XP, is preferable that this endpoint be the Target.

UDP

This protocol measures the Echo response received when packets are sent over UDP. UDP uses specified port numbers and checksums to check if the packets have arrived correctly, but does not guarantee reassembly of packets in the correct order.

- **Interval:** Set a value or use the default of 3 seconds.
- **Packet Size:** Select a value in bytes by defining the size of packets sent by the Source Endpoint to be used as probes.
- **Timeout:** Defines the period after which the sent packet is considered lost if not received by the recipient host, or use the default.
- **Peer port:** Only ports that are open on firewalls between the source and target machine can provide accurate results; if a port is closed the measurement will display complete packet loss. Choose **Auto Select** for Network Capture to scan a list of predefined list of ports to locate a port that's available.
- **Specific port:** Type or select a port number. Autoscan selects ports based on the defaults set in the **NC.Protocols.config** file located in **<Network Capture Agent home directory>\Bin\AgentImplementation**. You can modify this file to define alternate ports to be scanned.

ICMP

The Source Endpoint sends an ICMP Echo Request (ping) to the Target Endpoint; if the target is available, the target host responds by sending an ICMP reply back to the Source Endpoint. The Latency measurement is the round trip time.

Note: Ensure that the operating system on the Target Endpoint is configured properly to receive and process ICMP Echo Request and Reply messages, so that the ICMP Echo Request/Reply messages can travel along the path between the Source and the Target machines.

Interval: Select a value greater than 100 ms, or use the default of 1 second. When selecting a values less than 1 second use a short duration for the monitor, otherwise many samples are taken and the database may fill to capacity. Bandwidth may be measured with multiple concurrent monitors. For more information, see ["Defining the Interval for Concurrent Bandwidth Monitors" on page 33](#).

Packet Size: Select a value in bytes; the value includes the IP and ICMP headers.

Timeout: Defines the period after which the sent packet is considered lost if a response is not received by the agent.

Configuring Bandwidth

Bandwidth measurement can be of outbound and/or inbound traffic. When unidirectional bandwidth is recorded, the outbound bandwidth is measured and the incoming bandwidth is estimated according to a predefined ratio. When the bidirectional metrics are measured, both the outbound and inbound metrics are measured.

Three metrics can be recorded:

- Unidirectional Bandwidth
- Bidirectional Estimate Bandwidth
- Robust Bidirectional Sample Bandwidth

Unidirectional Bandwidth

Measures the outbound bandwidth availability and estimates the inbound bandwidth availability. Use this metric when you are unable to place an agent at the Target endpoint, for example a web server such as <http://www.example.com>. This protocol may place a moderate load on the network. Note that results may not be fully accurate when the network is undergoing heavy traffic conditions.

- **Interval:** Set to 2 minutes or higher, as each probe usually requires about 15 seconds. Bandwidth may be measured with multiple concurrent monitors. For details, see ["Defining the Interval for Concurrent Bandwidth Monitors" on page 33](#).
- **Pinging Protocol:** Recommended to choose **Auto Select**, which selects the first available protocol in the following order: NTP, ICMP Timestamp and then ICMP Echo. Each of these can also be selected individually. Both NTP and ICMP Timestamp provide more accurate results, and the response on the return trip is not influenced by the network conditions.

Note: To measure unidirectional bandwidth using the NTP pinging protocol, the NTP service must be enabled.

- **Port:** Type a valid Port number, or choose **Auto Select** for Network Capture to scan a list of predefined list of ports to locate an available port. Network Capture validates that the selected port is indeed available (i.e., not blocked by firewalls); and if not, the run is aborted. Autoscans selects ports based on the defaults set in the **NC.Protocols.config** file located in **<Network Capture Agent home directory>\Bin\AgentImplementation**. You can modify this file to define alternate ports to be scanned.

Bidirectional Estimate Bandwidth

This protocol measures bidirectional bandwidth availability. Both the Source and Target Endpoints require an installed HP Agent. Select Bidirectional Estimate to measure both upstream and downstream

bandwidth availability; polling usually occurs at three second intervals.

- **Interval:** Set to 2 minutes or higher. Bandwidth may be measured with multiple concurrent monitors. For more information, see ["Defining the Interval for Concurrent Bandwidth Monitors" on page 33](#).
- **Port:** Choose Auto Select for Network Capture to scan a list of predefined list of ports to locate an available port. To select a specific port, type a valid Port number, or use the up/down arrows. Network Capture validates that the selected port is indeed available (i.e., not blocked by firewalls), and if not, the run is aborted.
- **Probing Protocol:** This displays the protocol that is used to generate network traffic.

Robust Bidirectional Sample Bandwidth

Measures bidirectional bandwidth availability. Both the Source and Target Endpoints require an installed HP Agent. Accurate measurements are obtained when the bandwidth capacity is less than 50 Mbps and the Round Trip Time is less than 120 seconds. Bidirectional Sample places a substantial traffic load on the network.

Note: Due to a issue in MS Windows XP's implementation of the TCP/IP stack, Robust Bidirectional may measure lower than available bandwidth when the round-trip packet loss rate is high (higher than 2%) and the probing machine is Windows XP. This means that downstream available bandwidth results when Windows XP runs on the Target endpoint, and upstream results when XP runs on the source endpoint may be affected.

- **Interval:** Set to 2 minutes or higher. Bandwidth can be measured with multiple concurrent monitors. For more information, see ["Defining the Interval for Concurrent Bandwidth Monitors" on page 33](#).
- **Port:** Both the Source and Target require an installed HP Agent. Or Choose **Auto Select** for Network Capture to scan a list of predefined list of ports to locate an available port. To select a specific port, type a valid port number, or use the up/down arrows. Network Capture validates that the selected port is indeed available (i.e., not blocked by firewalls); and if not, the run is aborted. Autoscan selects ports based on the defaults set in the **NC.Protocols.config** file located in **<Network Capture Agent home directory>\Bin\AgentImplementation**. You can modify this file to define alternate ports to be scanned.
- **Probing Protocol:** This displays the protocol that is used to generate network traffic.

Configuring Web Server Parameters

HTTP Response Time measures the length of time required for the HTTP response to be received from the Target Endpoint. This includes DNS lookup time, TCP connection establishments, server processing time and network latency.

HTTP Response Time

Requires a web server at the Target Endpoint.

- **Interval:** Select a value, or use the default of 30 seconds.
- **HTTP Method:** Select **Get** or **Head** (Head usually provides more accurate results).
- **Timeout:** Defines the period after which the request is considered lost if no response is received from the web server. Select a value or use the default.
- **Resource Path:** The path to the requested resource, e.g. / or /index.html.

- **Port:** Select the port number on which a TCP/HTTP server is listening for incoming requests (by default 80 or 443) or type a specific port number.
- **Max Redirections:** The number of redirections to follow. Usually "0" since a reply from the Target Server is expected.
- **User Agent:** The user agent string to be used when contacting the web server. Some web servers may only reply to predefined agents. The default value uses the Firefox 4.0 user agent string.
- **Status Code:** Select the Status Code that is expected to be received from the web server. When a received status code does not match the one specified, the request is considered lost. Select a specific status code, or to accept any type of status code that does not indicate an error should be accepted by selecting **Any status code**.
- **Schema:** Select **secure (HTTPS)** or **non-secure (HTTP) communication**.

Start Monitoring

After configuring the Monitor, begin recording by clicking the **Run Monitor** button in the toolbar. Validation of various components occurs in this order:

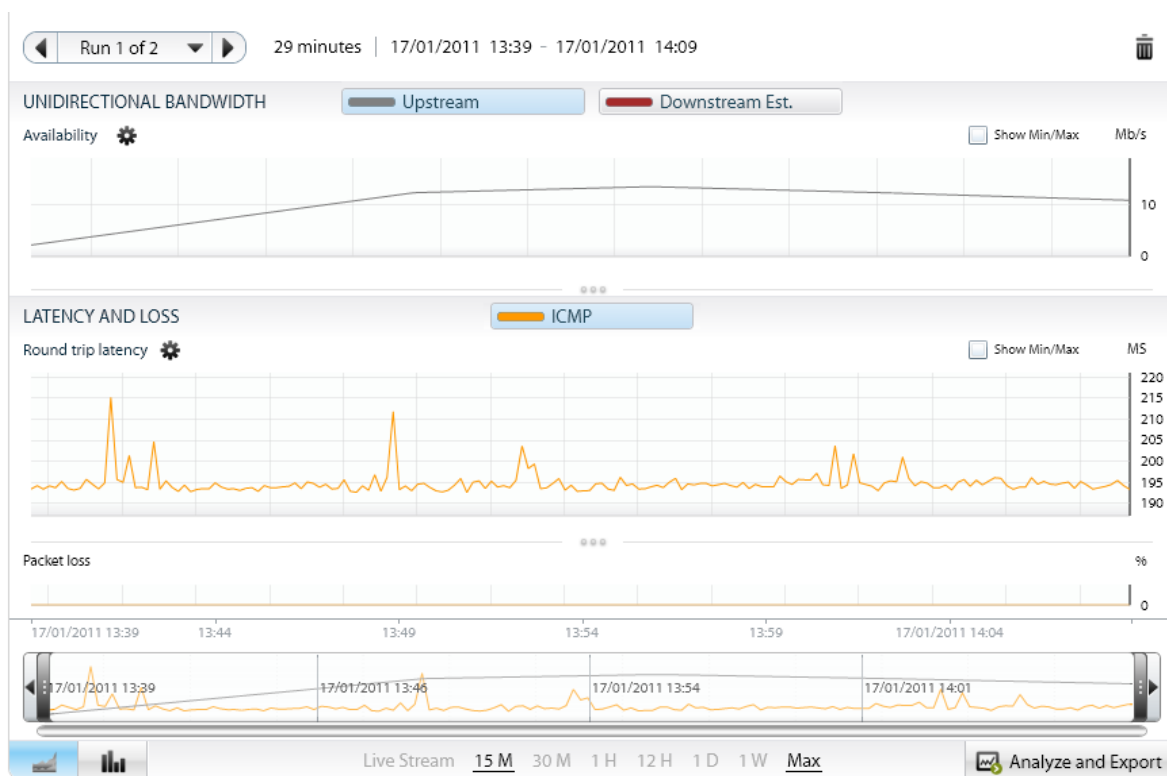
1. Source Endpoint can poll the Network Capture Server and obtain commands
2. Clock synchronization between the Network Capture Server, involved Agents and the host on which you are viewing results
3. Source Endpoint is able to send results to the Network Capture Server
4. Source Endpoint can communicate with the Target Endpoint (for peer-based monitors' only)
5. Port collisions do not occur

Note: If the Monitor does not start after the Initialization, see ["FAQs and Troubleshooting" on page 49](#).

Viewing Data


When you click **Results** from the Monitors page, Network Capture displays runtime results of the selected run for that monitor; by default the latest 15 minutes results are shown in the Line Chart view. To view offline results, click **Max** to view the entire time span.

Using Network Capture



The progress bar at the top indicates the Start and End time, and the percentage of time that has elapsed. You can view current and previous recordings.

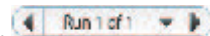
Note: If the Source Agent is not accessible for a certain period, the results curve connects the point where the last data was obtained with the result after the timeout, so that a continuous line is displayed.

Click the **Percentile Distribution Graph** icon  to display the data in a percentile distribution graph format.

Using Network Capture



If the monitor has run more than once, select the required run using the arrows.



You can open current and previous recordings (the progress bar is only visible for monitors that are currently running).



The status of each monitor is visible according to the icon beside the monitor's name:

	Currently running
	Indicates that a metric in the last run of this monitor did not run successfully
	Idle; not currently running or has completed successfully
	Currently running but some of the protocols have stopped running
	Error: only appears under the Results button if the run stopped with errors. Select this icon to view an explanation of the issue.

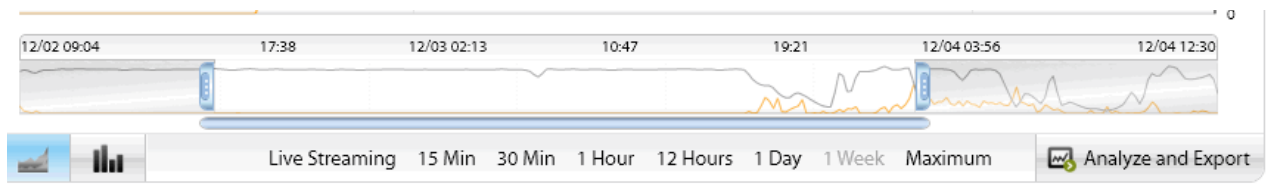
Note: If the Network Capture Server, Agent and the host on which you are viewing results clocks are not synchronized, the time displayed in the Results will not be correct; however, the results are still valid. To synchronize your clocks, in each host computer, ensure that the "Synchronize with an Internet Time Server" option is selected in the Time Settings.

Zoom In and Zoom Out

The granularity of the results shown depends on the length of the recording. Therefore for recordings of longer duration, to view more detailed results, use the Zoom to select a specific time period. By default the most recent results are shown, so that selecting a 12 hour period shows the last 12 hours, not the first 12 hours of the recording. Most of the following options are available in both Line charts and Percentile Distribution chart views.

To select a time range:

- At the bottom of the Results page click a Time Period, from 15 minutes to Maximum (the full range of the recording). Live Streaming: refreshes every with each new sample.



Use the following methods to select a specific time period:

- To find the exact instance of an event in a run, use the tooltip on the vertical blue line in the Results display to indicate the date and time.

Using Network Capture

23 hours, 58 minutes | 06/01/2011

NDWIDTH Upstream

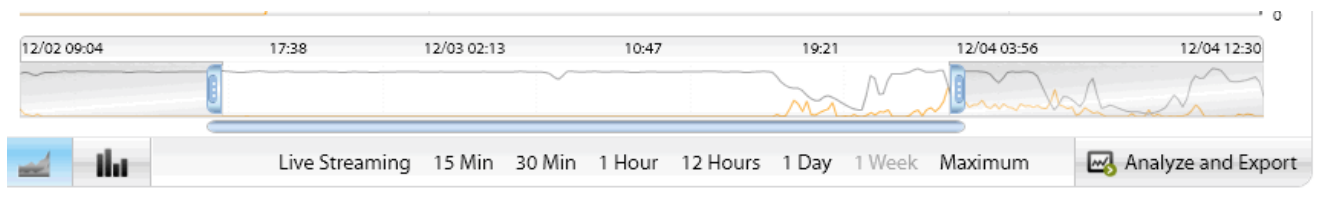
14.5 Mb/s



339.34 ms



- Adjust the range using the left and right slider bars to adjust the graph to the selected range.



- Slide the magnifier across the slider to the required time period.

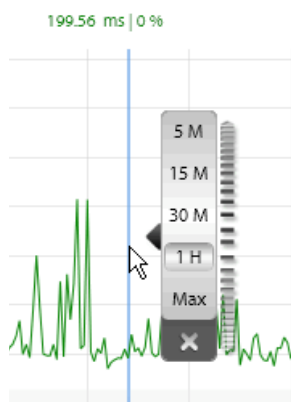


- Jump to previous time/next time frame using the arrows at the far left and far right of the slider.



Double-click the graph and use the mouse wheel to select the required time frame.

Using Network Capture

**To display Bandwidth as Availability or Utilization:**

1. In the Results page, click the **Bandwidth Settings** icon.
2. In the Bandwidth Settings window, select **Availability** or **Utilization**. If you select Utilization, supply the value for the Link Capacity.

To configure Latency and Loss Settings:

1. In the Results page, click the **Latency and Loss Settings** icon.

2. In the Latency Settings select **Roundtrip** or **One-way measurements**.

Searching for Data

You can search for data in the current view by entering either free text, or by selecting one of the drop-down options. A pre-defined search displays all those monitors with a specific status.

Analyzing Data

As Network Capture collects data, you will probably be wondering how to use the data to best advantage when emulating these conditions in HP's performance applications. You'll be exporting a file that contains about a half hour of data, so you'll want to ensure that each file provides a picture of the network at crucial periods.

To analyze the data:

1. In the Results page, click **Analyze and Export** below the graphs.
2. To quickly view specific time periods, select a time period in the **Analyze** section.
Select the time period for which to show these conditions; 1 or 5 minutes are often sufficient. For a longer time span, select 15 or 30 minutes. To export the results, choose the displayed time period or the entire run, according to either latency or bandwidth calculations. For more information, see ["Exporting Data" on page 46](#).
3. For more detailed statistics, select **Performance Statistics**.

Performance Statistics

Bandwidth

The results display the available bandwidth.

The **Lowest** displays lowest observed bandwidth results for selected period.

The **5th Percentile** displays lowest measured bandwidth conditions for selected period excluding rare occurrences.

The **95th Percentile** displays highest observed bandwidth results for selected period, excluding rare bursts or outermost conditions.

The **Typical** displays the geometric mean of the selected period, which indicates the most representative bandwidth conditions.

The **Highest** value displays highest observed bandwidth conditions for selected period.

Latency (Round Trip) and Packet Loss

Low identifies the period with the lowest latency/loss conditions during the selected time-frame.

The **95th Percentile** displays results with the lowest observed latency and packet loss for selected period, ignoring infrequent dips.

The **Mean** value shows the geometric mean of the latency and packet loss (default) or bandwidth measurements, and indicates the most common network conditions in your network. When testing application response time, use this value to simulate typical transaction response.

The **5th Percentile** displays the highest observed latency and packet loss for selected period, but ignores rarely occurring peaks.

Highest identifies the period with highest latency/loss conditions during the selected time-frame.

The **Average Loss** (relevant only for Packet Loss) displays the calculated average of the packets lost in the defined period.

Tips

Use the slider bar to find network conditions for a specific time of day, or use the analyses to find the lowest, mean or highest 1, 5, 15 or 30 minute time frames.

Using Network Profiles

Network Profiles utilize data from monitors that were recorded by Network Capture, or from external sources. These recording can be analyzed so that best, worst or typical conditions obtained during the recording period can be isolated. These conditions can be exported in .ntx format to be used in testing emulations.

Note: When importing a recording in the HP Network Virtualization Modeler's Cloud Shape, the Network Profile is present instead of Monitors, which were present in previous versions of HP Network Capture (formerly Shunra NetworkCatcher).

Network Profiles provide actual recorded network conditions for these types of monitors:

- Mobile
- Stationary
- Monitor-based

The data can be selected according to the Geographic Source and Target, Type of communication, and Duration.

To create a Mobile Profile:

1. Select the **New Profile** icon ; by default a Mobile profile is created. The Profile name can be up to 255 characters.

Note: To create a Stationary or Monitor-base profile, select the required option in the drop-down list, see below.

2. Select the Source and Target cities in the From and To lists.
3. Select the type of connection, either WiFi or Cellular (additional options are available by clicking the **Settings** icon).
4. Select the Device.
5. Select Latency and/or Bandwidth and one of these conditions:
 - **Best:** most favorable observed conditions for selected period
 - **Typical:** geometric mean; displays the most representative conditions
 - **Worst:** displays lowest observed conditions for selected period
6. Select the Emulation Time (duration) of the recording, from one minute to two hours.
7. Select **OK**, or **Save and Add Another**. Network Capture calculates the conditions according to the selected parameters and the results are displayed.

To create a Stationary Profile:

1. Select **Stationary** from the drop-down list beside the **New Profile** icon.
2. Select the Source (client or data center); the Target is a data center.
3. Select **Latency** and/or **Bandwidth** and one of these conditions:
 - **Best:** most favorable observed conditions for selected period
 - **Typical:** geometric mean; displays the most representative conditions
 - **Worst:** displays lowest observed conditions for selected period
4. Select the Emulation Time (duration) of the recording, from one minute to two hours.
5. Select **OK**, or **Save and Add Another**. Network Capture calculates the conditions according to the selected parameters and the results are displayed.

To create a Monitor-based Profile from the Profiles module:

1. Select the Monitor-based from the drop-down list beside the **New Profile** icon.
2. Select the Monitor and then **Run**.
3. Select the Latency metric, such as TCP or HTTP.
4. If Bandwidth was measured, select the Bandwidth metric, such as Bidirectional Estimate.
5. Select one type of conditions:
 - **Best:** most favorable observed conditions for selected period
 - **Typical:** geometric mean; displays the most representative conditions
 - **Worst:** displays lowest observed conditions for selected period
6. Select the Emulation Time (duration) of the recording, from one minute to two hours.
7. Select **Find by Latency** to display the interval with the required conditions according to the latency values, or **Find by Bandwidth** to display the interval in which the required conditions are displayed according to the bandwidth measurements.
8. Select **OK**, or **Save and Add Another**. Network Capture calculates the conditions according to the selected parameters and the results are displayed.

To create a Monitor-based Profile from the Monitoring module:

1. Select the Monitor and **Run**.
2. Analyze according to the required conditions, or manually select the requested time interval.
3. Ensure that other than Bandwidth, only one metric is selected.
4. Open **Analyze and Export**.
5. Select **Save as Network Profile**.
6. Select a Profiles folder, enter a name for the Profile and click **Save**.

Exporting Data

To conduct a network emulation using your actual network conditions, export data from Network Capture in an .ntx file. Then, in the HP Network Virtualization network appliance, or HP Network Virtualization desktop applications, import the file and emulate your network conditions with the recording. Only one metric of either latency and packet loss, or of bandwidth can be present in each .ntx file.

To emulate with the HP Network Virtualization desktop applications, up to 900 Latency and Packet Loss samples can be exported per metric. The number of samples present in the Export file also depends upon the default Interval settings per metric. To alter this Interval in the data that is being exported, using zoom bar, select the time frame for which to export the data.

To emulate with the the HP Network Virtualization network appliance, up to 90,000 samples can be exported. This setting can be modified in the Administration module, Settings.

Note: The Export option may appear to be disabled at first, until the data updates. Export requires supplementary licensing.

To export data:

1. In the Results or Network Profile page, click **Analyze and Export** below the graphs.
2. Select an Export option:
 - Export viewed time frame (when the current view shows a specific portion of the complete run)
 - OR
 - Save as network profile (from HP Network Virtualization emulation applications, these profiles can be uploaded)
3. Save the file to the required location.

To modify the Export settings:

1. In the Results or Network Profile page, click **Analyze and Export** below the graphs.
2. Select **Settings**, which links to Administration > Settings > Export. These settings can also be accessed directly in the Administration module.

Defining and Updating Users

New users can only be defined, modified and deleted by users with Administrator permissions. Operator can view their own and others' details but not modify them; they can only change their own passwords. For details, see ["Account Settings" on the next page](#).

To define a new user:

Note: Only Administrators can add Users.

1. In the Administration module, click **Users**.
2. Click the **New User** icon and define the properties. Select the account type:
 - Administrator: full permission
 - Operator: can create and modify monitors but cannot create or modify users, endpoints or other settings
3. Define a password of up to 20 alphanumeric characters.

To change the user details or password of a user:

Note: Only Administrators can modify User details.

1. On the Administration page, click **Users** in the Network Capture toolbar.
2. Double-click a user and modify the User's properties as required. Only the User Name, Phone number and Password can be modified.

To delete a user:

Note: Only Administrators can delete users; however the system-defined Administrator cannot be deleted.

1. On the Administration page, click **Users**.
2. Select a User and click the **Delete User** icon.

All users can reset their own passwords by clicking the "**Regenerate and send password by email**" icon.

Account Settings

To view your account details, click the **Account Settings** icon in the toolbar. The Name and User Name cannot be modified, but the other fields can be updated.

The screenshot shows a dialog box titled "Account Type - Administrator". It contains the following fields and controls:

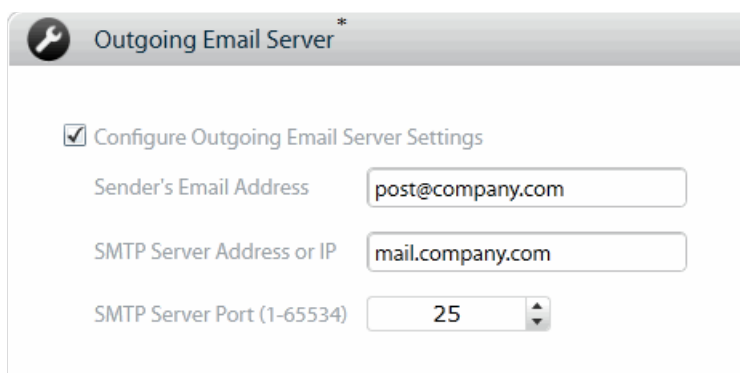
- Name:** Admin
- Email:** a@adminland.com
- User Name:** Administrator
- Phone Number:** 1-800-admin
- Change password:** A button located below the User Name and Phone Number fields.
- OK** and **Cancel** buttons at the bottom right.

Outgoing Email Settings

To reset a password or conduct certain other account updates, valid SMTP Mail Settings must be set. These settings can be configured during installation, or post-installation by selecting **Administration module > Settings > Outgoing Email Server**.

- **Sender Email Address:** type the email address from which the emails are sent.
- **SMTP Server:** type the DNS or IP address of the SMTP Server which sends the email.
- **Port:** by default port 25, or type a different port number.

This configuration does not guarantee that the email will be sent, since networking, authorizations and other factors may prevent this operation. For these issues, contact your System Administrator.



Outgoing Email Server *

☒ Configure Outgoing Email Server Settings

Sender's Email Address:

SMTP Server Address or IP:

SMTP Server Port (1-65534):

Setting Schedules

Use the Scheduler to start and end a Monitor's recordings according to specific timetables. Schedules can be created when defining a Monitor, or later, but not while the Monitor is running. The Scheduler sets the time according to the time on the machine on which you are defining the Monitor.

To set a Schedule:

1. When defining or editing a Monitor, click the **Scheduling** button.
2. Define the Start and End Times, Set the recurrence if required. The recordings can be set to recur daily, weekly or monthly.
3. Define the duration of each recording.

FAQs and Troubleshooting

I am not able to create a new network profile. The From and To dropdown lists are empty. What should I do?

This occurs when the Network Capture server is behind a proxy.

Locate the HP Network Capture Server service. Go to the service properties, and on the **Log on** tab select **This account**. Enter the administrator user name and password, and restart the service.

I installed the Network Capture Server, and I'm able to open the Network Capture webpage, but I can't log in. Instead I get this error "Communication with Server failed". What should I do?

Start by verifying that the Network Capture Server Service is Started.

Validate that ASP.NET 4.0.30319 is Allowed (depending upon the operating system, in the Web Server (IIS), IIS Manager.

Validate that the .svc file type is mapped to aspnet_isapi.dll. For further information, refer to: <http://msdn.microsoft.com/en-us/library/ms752252.aspx>.


Installation of a secured Network Capture Server fails with this error in the log "ERROR: The input is not a valid Base-64 string as it contains a non-base 64 character, more than two padding characters, or a nonwhite space character among the padding characters."

1. For information regarding a bug in IISCertObj component on Windows 7 and Windows 2008R2, refer to: <http://support.microsoft.com/kb/982386/en-us>.
2. Install the hotfix as recommended in the article listed above.
3. Reinstall the Network Capture Server.

The Network Capture Server does not start - what next?

Open the MySQL Instance Configuration Wizard and configure a Standard Instance.

An Endpoint is unreachable (red) - what can I do?

First click the **Scan all endpoints** button . The issue may have been resolved since the last scan, or the **Endpoint** icon could be red if no scans have been conducted yet. If it's still showing as inaccessible after the scan, check:

- That the Network Capture Agent Service is active.
- Firewall settings (for details, see "[Firewall Configuration](#)" on page 19).
- For Remote Agents, validate that the Server host name can be 'pinged' from the Agent host.
- To test to see if the problem is from the Source to the Target, or from the Target to the Source, you can start two different monitors in which both the Source and Target. The error message will list the element in the connection in which the problem occurs.
- You may have noticed a message during the installation that Port 80, which is required by the Network Capture Agent is already in use. To remedy this situation, determine which component is utilizing this port and assign another port to the component. Restart the HP NC Agent Service, then click **Scan all Endpoints** and the issue should be resolved.
- If this is not successful, contact support at <https://softwaresupport.hp.com/>.

I'm using Internet Explorer and I can't download the Network Capture Agent

To be able to download the agent via the browser, you'll have to adjust the following settings:

1. In Internet Explorer, open Tools > Internet Options, and select the Security tab.
2. Select **Internet** under **Select a zone to view or change security settings**.
3. Select the **Custom** level.
4. Select **Downloads** in these settings and enable the following:
 - Automatic prompting for file downloading
 - File download

Why won't my peer-based measurement start?

When you select a peer-based protocol, if the port that you have selected on the Target machine is already in use, Network Capture is unable to conduct the measurement.

The Initializing Monitor page is stuck on one of the steps, what should I do?

Close the Initializing Monitor page, click **Refresh All** and restart the monitor.

How can I look for information?

Network Capture provides extensive search capability, whether you are looking for monitors, endpoints, results and so on. For details, see ["Searching for Data" on page 43](#).

I've set Monitors to measure Unidirectional and Bidirectional Bandwidth, but the Monitors are aborted. What could be causing this problem?

Although a number of issues could cause this problem, a common reason is that IPv6, which is not supported in NetworkCatcher v7.0, is enabled. To resolve this issue, on the Source Agent host, deselect **IPV6** (depending upon your operating system, usually located in the **Local Area Connection Properties, Networking tab**).

I reset a password but the email with the new password was not received?

Check the Outgoing Email Server settings (Administration module) to ensure that they are up to date. If this does not solve the problem, contact your system administrator as this issue may be related to SMTP configuration issues.

I really like the user interface design, but something got messed up, the buttons are on top of each other and some of the images are crooked. What's going on?

Set your screen resolution to 1280x800 or higher, with a zoom level of 100%.

How can I save the results?

In the Results view, select **Analyze and Export**, and then save the data in an .ntx file format. For more information, see ["Exporting Data" on page 46](#).

I'm running Network Capture on Windows 2008 and some Monitors are aborted, the error says something about "packet duplication". What can I do?

1. To conduct certain peer-based measurements, ensure that IP Routing is disabled. To disable IP Routing (advanced users only): In the registry editor, navigate to
HKEY_LOCAL_MACHINE \SYSTEM\CurrentControlSet\Services\Tcpip\Parameters
Select the **IPEnableRouter** entry.
2. To disable IP routing for all network connections installed and used by this computer, assign a value of 0.
OR
In the **regedit.exe**, right-click the entry, and then click **Modify**. In **regedt32.exe**, click the required entry > click **Edit** > click the appropriate menu entry.
3. Close the registry editor, then reboot.

Can I view results while Network Capture is recording?

Of course! As soon as you hit the Run Monitor icon, the Results view appears. You might have to wait just a bit until the results are shown in the graph as Network Capture collects the data. Soon you should be able to see a line graph or percentile distribution graph of the latency, packet loss and/or bandwidth until the monitor has run the full duration. After some time has elapsed you can view a specific period, or the entire duration. For details, see ["Viewing Data" on page 38](#).

I selected "Refresh All" or "Scan Endpoints" and it won't stop.

Check the Network Capture Service, if it's Stopped, start it. Then select **F5** to refresh the browser page. If this is unsuccessful, contact support at <https://softwaresupport.hp.com/>.

How many monitors can I run concurrently?

If you have a professional license you can run up to 25 Monitors concurrently.

Why do I need folders?

Well, you might not, you can keep all your monitors in the default folder that is present when you first open Network Capture. However, folders keep your monitors organized, and as you use Network Capture you may have many scenarios. You can choose to group your monitors according to various criteria, such geographic locations, types of applications, etc.

- To add a folder, click the **Add Folder** icon and rename the folder.
- To add subfolders, under each folder, click the **New Folder** icon when the Folder is selected and rename it.
- You can also drag and drop Monitors from one folder to another.

Can I delete a folder?

Yes, as long as the folder or its subfolders do not have any active runs that are currently recording.

How many Agents should I install?

The Network Capture Agent is installed as part of the Network Capture Server.

Therefore, you can measure latency, packet loss, or upstream bandwidth availability from the Server without installing the Network Capture Agent in any other location.

For example, if you have installed Network Capture in a datacenter in New York and need to measure latency, packet loss, and upstream bandwidth to any other location addressable over the network, you can do so without deploying additional Network Capture Agents. If the Network Capture Server is behind NAT, it can partake in both peerless and peer-based monitoring.

However, there are a couple of scenarios where additional agents are required:

- ["Measuring from a Secondary Location" below](#)
- ["Measuring Bidirectional Bandwidth Availability" on the next page](#)
- ["Defining the Interval for Concurrent Bandwidth Monitors" on page 33](#)

Measuring from a Secondary Location

For example, if you have a Network Capture Server installed in your data center in New York, but you require latency, packet loss and upstream measurements from London to a destination in Tokyo, you could install a Network Capture Agent in London. Then you could measure these metrics from London to Tokyo.

Using Network Capture



Measuring Bidirectional Bandwidth Availability

To measure bidirectional bandwidth measurements to any location, you will also need an Agent at the Target location. For example, to measure from New York to Tokyo, you will have to install an agent in Tokyo. This also applies to measurements from London to Tokyo.

Note that the same Agent may be the Target for one measurement, yet be the Source for another.



Obtaining Technical Support

Technical support is available to all HP Software Ltd. customers through the HP NV site <http://hp.com/go/nv>. Technical support may be obtained through the support site, <https://softwaresupport.hp.com/>.

Using Network Capture

Send Us Feedback



Can we make this User Guide better?

Tell us how: SW-Doc@hp.com

EXHIBIT F

Shunra NetworkCatcher™

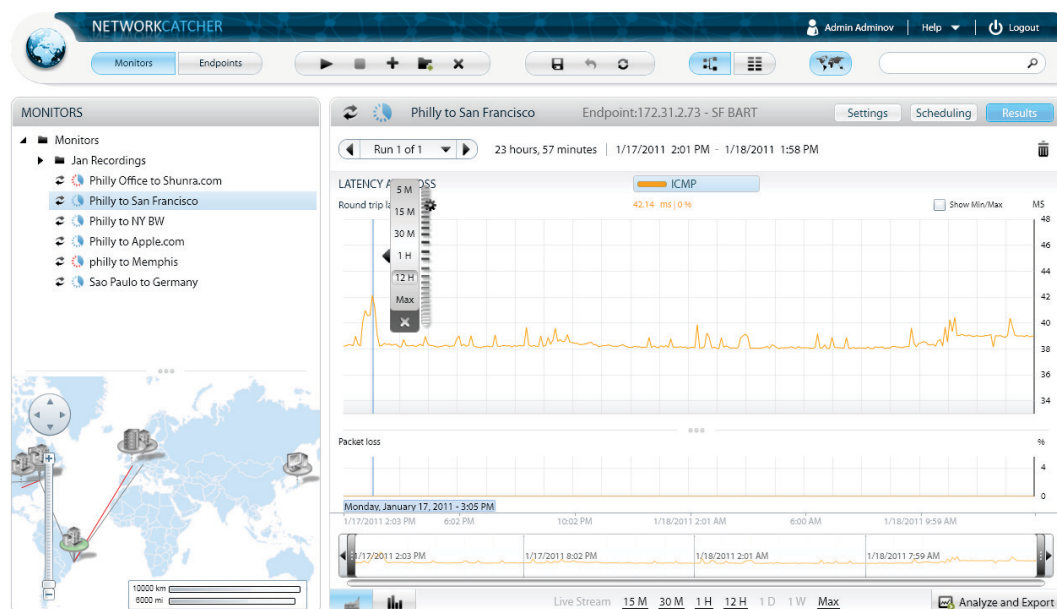
Capture Real-World Network Impairments Including Latency, Packet Loss and Bandwidth

About Shunra

When deploying applications across WAN, Web, Mobile or Cloud-based networks, risk mitigation and cost avoidance are paramount. Today, 80% of the costs associated with application development occur in remediating failed or underperforming applications after deployment, when the ineffective application has already had a negative impact on the end user or customer experience.

Shunra offers a proactive approach to application performance engineering (APE). The Shunra solution discovers, emulates, predicts and analyzes the performance of applications over real-world networks. As a result, Shunra delivers customized performance insight, enabling pre-production remediation and optimization, and confidence in application performance prior to deployment.

Shunra is the industry-recognized authority in Application Performance Engineering (APE), offering over a decade of experience with some of the most complex and sophisticated networks in the world.



It is often difficult to know and precisely emulate network behavior in a pre-production test environment due to the constantly changing nature of a production network. Shunra NetworkCatcher is a highly flexible and powerful network monitor that enables organizations to easily and accurately record, import and replay real-world network behavior, including conditions such as latency, packet loss and available bandwidth.

NetworkCatcher enables unsurpassed precision in recreating production network conditions in a pre-deployment test lab. With Shunra PerformanceSuite™ and NetworkCatcher powering the application test environment, organizations are able to test applications under the most accurate and true-to-life conditions possible.

Automated Recording and Playback of WAN, Web, Mobile and Cloud Networks

NetworkCatcher enables scheduled recording and automated analysis of network behavior, including the ability to quickly identify best-case, worst-case and average network performance. Using a flexible set of network communication protocols, NetworkCatcher captures network behavior and provides insight into how the

network responds to ICMP, UDP, HTTP and TCP communications. Network characteristics are easily gathered and analyzed by Network Catcher for use in Shunra Performance Suite, enabling a precise emulation of production network conditions in your test lab. To facilitate rapid testing of mobile applications, NetworkCatcher also features a searchable library of global mobile and broadband network profiles, enabling organizations to quickly test applications against typical network conditions between major cities.

Automated Playback of Network Behavior

Record and playback network behavior of links across the entire production network

- Record, store, analyze and playback link conditions
- Actively monitor the behavior of multiple links 24x7
- Replay production network conditions in the development/test environment
- Enable recorded network statistics at set intervals to playback from a central repository
- Seamlessly import production network conditions into the Shunra test environment
- Safe and secure: does not detect or store network traffic

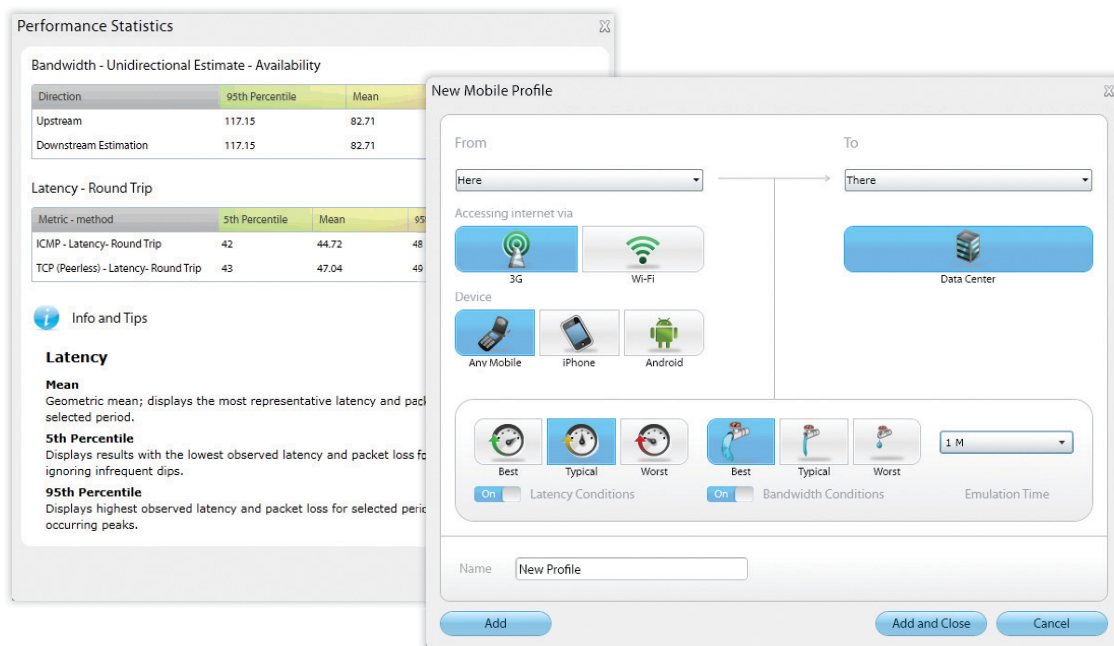


About Application Performance Engineering (APE)

APE is the discipline applied at every phase of the application lifecycle that ensures an application will be designed, implemented and operationally supported to meet its non-functional performance requirements. APE includes the roles, skills, activities, practices and solutions required to confidently deploy and manage application performance.

APE — Best Practices

- **Discovery:** identify and record real-world infrastructure and network conditions, business processes, application topology and deployment scenarios
- **Test Set-Up:** incorporate network behavior, network emulation and business process automation scripts into the test environment
- **Testing:** integrate with automation tools and enable single-user and multi-site/multi-user load testing
- **Analysis:** conduct thorough results analysis to identify potential bottlenecks and validate performance and SLO compliance
- **Remediation and Optimization:** implement recommended best practices to improve performance and calculate performance ROI



Why NetworkCatcher?

- Record network conditions between end users and the datacenter for accurate performance testing, and conduct the most accurate scalability testing possible
- Record conditions to and from multiple locations simultaneously for WAN, Web, Mobile and Cloud
- Pre-recorded library of global mobile and broadband network profiles enables rapid testing of mobile applications
- Identify best-case, worst-case and average performance values within a given period of time
- Built-in bandwidth availability measurements: unidirectional estimate, bi-directional estimate and bi-directional sample
- Measure the latency between two locations using a TCP Handshake

Contact Us

Call: 1.877.474.8672 | Email: sales@shunra.com | Visit: www.shunra.com

Key Features

- Pre-recorded network profiles for emulating typical mobile and broadband network conditions between major global cities
- Measure and record real network conditions for any reachable location using ICMP, TCP or UDP
- Go anywhere agent can be deployed securely to remote machines without the need to open multiple firewall ports
- Schedule and record up to 100 different monitors simultaneously for up to 30 days and store recordings indefinitely
- Easily find network conditions within a specific time period using a graphical zoom bar
- Export network conditions for replay in test environment
- Support for 32- and 64-bit Windows Server 2008 and 2003 OS
- Built-in MySQL database stores thousands of network profiles

EXHIBIT G



Data Sheet

Application Development, Test & Delivery

LoadRunner

Micro Focus® LoadRunner software is the industry-standard software for performance engineering. Generate real-life loads. Identify and diagnose problems. Deploy with confidence.

Understanding Application Performance

How do you know whether your mission-critical applications meet the performance and scalability requirements of your business? How do you decrease the risk of a catastrophic failure when deploying to production? Are your applications performing optimally?

Enterprise applications are becoming increasingly complex. With modern applications, there are many moving parts that can easily become points of failure if not tested prior to deployment. Platforms such as mobile, Cloud, and hybrid environments offer their own share of challenges. LoadRunner software, used by thousands of businesses around the world, is a comprehensive solution for testing system behavior and performance. It provides an efficient and robust means to verify that your application's architecture is built for more efficient performance and reliability. LoadRunner helps you:

- Test a broad range of applications, including the latest Web and Mobile technologies, ERP/CRM applications, and many legacy systems.
- Run high-scale tests using minimal hardware, including any mix of physical and virtual environments, including public Cloud infrastructure.
- Identify end-to-end performance bottlenecks using advanced monitoring and analysis tools, and ensure that new or upgraded applications meet the performance requirements of your business.

The Inside Story on LoadRunner

With an intuitive record and playback mechanism, including the patented TruClient technology, LoadRunner reproduces real business processes that a user would perform in production. These scripts can then be easily modified to emulate real user behavior.

LoadRunner then emulates hundreds or thousands of concurrent virtual users, with minimal hardware, to apply accurate workloads to any application. As it drives load against the system, LoadRunner captures end-user response times for business processes and transactions to determine whether the application can meet the required service-level agreements. Non-intrusive, real-time performance monitors from Micro Focus SiteScope captures real-time performance data from every component of application infrastructure, while Micro Focus Diagnostics collects application-layer and code-level performance data. By leveraging Micro Focus Network Virtualization and Micro Focus Service Virtualization, you can eliminate and control unknown variables and isolate performance risks.

After the test completes, the LoadRunner analysis engine provides a single view of end-user response time, infrastructure-level and code-level performance; and includes the patented auto-correlation engine to identify the most likely causes of performance issues.

[Click here to learn how LoadRunner can help you deliver high-performing applications.](#)



Data Sheet

LoadRunner

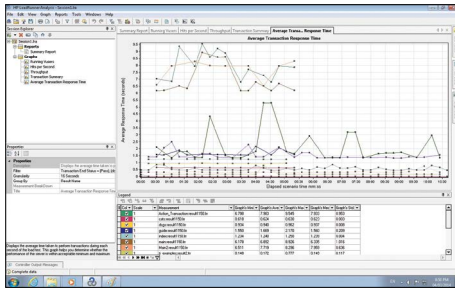


Figure 1. LoadRunner Analysis: A view of cross-results trending capabilities, showing a comparison of increased system scalability and optimized response-time performance

Test Against a Broad Range of Applications and Protocols

LoadRunner supports performance testing for a wide range of application environments and protocols, including Web/Mobile, Web services, MQ, HTML5, WebSockets, AJAX, Flex, RDP, Database, Remote Terminal Emulators, Citrix, Java, .NET, Oracle, and SAP. An easy-to-use scripting and debugging engine leverages data format extensions and correlation studio to reduce the amount of time spent scripting.

Simplify Analysis and Reporting

With its Bubble-Up analysis capabilities, LoadRunner helps you quickly determine which transactions passed or failed the set service-level objectives, as well as some potential causes of failure. A strong analysis engine helps you slice and dice data in many ways to easily pinpoint the root cause of the problems. You can also use templates to generate multiple custom reports to serve the needs of various stakeholders.

Record and Replay a Variety of Web 2.0 Technologies

TruClient technology is a browser-based virtual user that supports next-generation Web-based

applications. TruClient is embedded in the browser and provides interactive recording and scripting, dramatically reducing the amount of programming required. This gives you the ability to various levels of user activity, from the GUI level down to the transport and socket level, depending on the skill set available and the level of customization required. TruClient supports most AJAX applications, regardless of the framework used; making testing of Web 2.0, and Mobile Web applications faster, easier, and more comprehensive.

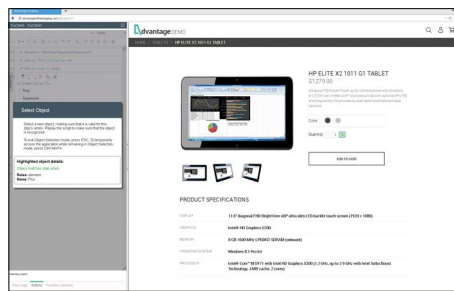


Figure 2. The patented Micro Focus TruClient technology provides a browser-embedded, interactive way of scripting next-generation Web-based applications

Scale Up Tests Leveraging the Public Cloud

LoadRunner supports testing of applications on all platforms. Whether the application is running in the cloud or in-house, on bare-metal or virtual machines, or in a hybrid environment; LoadRunner can help test the application before it goes live, so that you can deploy with confidence.

With cloud testing, you can quickly and elastically scale up tests to meet the demands of your customer-facing business applications, reducing the cost and overhead of managing dedicated machines. LoadRunner now

provides the ability to seamlessly leverage public cloud infrastructure to deploy load generators (LGs) to scale up and down based on your performance testing needs, without complicated network configuration.

The deployment of cloud-based LGs is built into LoadRunner, significantly reduces provisioning time, while maintaining security and control. You can add multiple cloud accounts and manage network profiles for connecting to your various LGs. You can also secure host communications using public/private key pairs, and provision hosts using standard templates or by creating your own. Tests can be executed with any mix of load generators within your network or in the public cloud in the cloud. We support various cloud environments such as Amazon EC2, Microsoft Azure, Google Compute Engine, or DigitalOcean.

LoadRunner is now available in the Microsoft Azure Marketplace and Amazon AWS, providing you the flexibility to run your load and performance testing from the cloud, reducing infrastructure costs to execute your tests.

Deliver Enterprise Load Generation, Monitoring, and Diagnostics

LoadRunner can generate realistic loads scaling up to hundreds and thousands of virtual users (VUs) to reproduce realistic conditions. LoadRunner integrates with SiteScope to provide more than 60 non-intrusive monitors to measure the impact of load testing on every component of the application. LoadRunner also seamlessly integrates with Diagnostics, allowing you to drill down into applications level issues to find the root cause of problems across heterogeneous application stacks; including J2EE, .Net, SAP, Oracle and SOA based applications.

Mobile Application Testing

LoadRunner is the most complete solution for mobile application performance testing; including Mobile Web, Native and Hybrid applications. The TruClient—Mobile Web protocol supports the rapid testing of browser-based mobile applications, and the TruClient—Native Mobile protocol provides support for native, Web and Hybrid applications. Micro Focus solutions for mobile testing can be used to test mobile applications against any platform and OS. LoadRunner seamlessly integrates with **Network Virtualization** enabling realistic network conditions during each test.

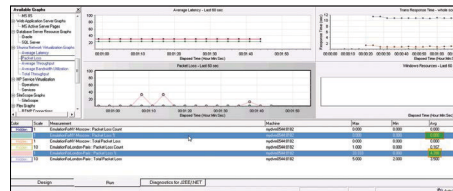
Mobile Application Recording Options

When it comes to Mobile testing, one method does not fit all. Whether you have access to a physical device, application or device emulator, or traffic capture from any available Mobile device cloud; the methods used for capturing application usage will vary with each deployment model. That is why LoadRunner includes multiple methods for recording Mobile application scripts, to meet the needs of any Mobile development project. Virtual User Generator supports the following Mobile application scripting methods:

- Server-side traffic capture
- PCAP traffic recording
- Mobile Device Emulator
- Proxy recording
- TruClient—Mobile Web (for mobile-web applications)
- TruClient—Native Mobile (for native, browser-based, or hybrid mobile applications)

Network Virtualization Support

Mobile application performance is critical to the success of a business. As much as 70% of the application response time is caused by network conditions, and optimizing applications to run on Mobile is impossible without including realistic network conditions in each test. The impact of network conditions isn't only on Mobile users, but on the entire application infrastructure. That is why LoadRunner seamlessly integrates with Network Virtualization to capture and include realistic network conditions during each test.



Continuous Testing Support

Integrations for Developers

To enable load testing earlier in the application lifecycle—which is particularly relevant in agile environments—LoadRunner provides IDE to integrate with leading development environments Visual Studio and Eclipse; allowing developers to run unit tests using the LoadRunner engine. This integration lets Developers create LoadRunner scripts directly within the IDE, and contribute to performance testing efforts earlier in the application lifecycle. LoadRunner also supports execution of JUnit, NUnit and Selenium scripts as part of the test scenario, allowing you to leverage Unit tests the developers are already creating. LoadRunner integrates with Git Hub too, allowing you to upload scripts from a Git repository.

In addition, the Diagnostics Profiler software allows Developers to view and debug performance issues at the code level within their test environment.

Continuous Delivery

LoadRunner provides an addin for Jenkins Continuous Integration platform: this add-in executes LoadRunner scenarios and reports pass/fail status at the end of a build job. There are also APIs for automating the analysis and reporting of completed tests.

Community Content

To connect users within the largest performance engineering community in the world, LoadRunner integrates with the [AppDelivery Marketplace](#). The AppDelivery Marketplace provides a single portal for Micro Focus performance testing users and partners to share and distribute content with the entire user community, who can access and automatically install Function Libraries, Correlation Rules, Data Format Extensions and other add-ins directly from VuGen.

Additional Micro Focus Application Lifecycle Integrations

To facilitate intelligent release decisions, LoadRunner is integrated with industry-leading quality software, such as Micro Focus Quality Center (QC), and Application Lifecycle Management (ALM). Leveraging these complementary products together with LoadRunner provides a comprehensive solution for managing release risk, so you can make informed decisions prior to going live.

Complete integration with Micro Focus Unified Functional Testing (UFT) and LeanFT helps bridge the functional testing gap and eliminate the risk caused by external dependencies component services. API tests authored in UFT can be executed directly in the LoadRunner Controller as part of a performance test.

Integrations with Production

Application-performance and service-level management doesn't end when load testing is done. In fact, service-level management begins when the system goes live. During the transition from prerelease to production, you can use LoadRunner scripts within Micro Focus Business Systems Management (BSM) software to monitor application performance, availability, and service levels in production under real-user workloads. Common technologies in Micro Focus products such as Diagnostics and SiteScope, which integrate with both LoadRunner and BSM, help bridge the gap between testing and production. These integrations, both upstream to QA and downstream into production, make LoadRunner an ideal solution for performance engineering across the application lifecycle.

LoadRunner Key Benefits

- Reduces cost of application downtime related to performance issues in production
- Supports performance testing of new technologies together with your existing, legacy applications
- Accurately tests a mix of mobile and Internet users, reducing the risk of performance bottleneck when bringing new mobile applications to production
- Decreases the risk of deploying systems that do not meet performance requirements
- Reduces hardware and software costs by accurately predicting application scalability and capacity

- Helps you establish intelligent service-level agreements before applications go live
- Shortens test cycles to accelerate delivery of high-quality applications
- Pinpoints end-user, system-level, and code-level bottlenecks rapidly and with ease
- Reduces the cost of defects by testing earlier in the application lifecycle

LoadRunner Helps Detect Pre-Production Issues

“With the help of LoadRunner through load testing in general we have found many issues that we would not have been able to handle in production without loss of service and business.”

IT MANAGER

Large enterprise financial services company
(TVID: F3E-C13-172)

See what other customers are saying about the new [Micro Focus LoadRunner software](#).

About Micro Focus Software Application Delivery Management Solutions

Software Application Delivery Management solutions help ensure modernization initiatives deliver business outcomes instead of failing under the burden of outdated, legacy delivery mechanisms. Where rival solutions mistake the software development lifecycle for a total picture of the application, Micro Focus sees core delivery in the context of the complete application lifecycle—from business idea through

retirement. Furthermore, by providing unified management and automation solutions, Micro Focus offers customers not simply more tools and integrations, but greater simplicity. The result for enterprise application teams is improved predictability, repeatability, quality, and change readiness in both the core and complete lifecycle.

Micro Focus Performance Testing Offerings

Performance Testing from Anywhere, for Any Size and Any Type of Environment

The agility in how business wants IT to deliver has drastically increased. Micro Focus's objective is to provide a menu of options on performance testing solutions to support any type of environment, application, methodology, maturity, and consumption model that the customer have to allow them to accelerate the delivery applications that perform with quality.

Micro Focus provides high-quality software and services that address all aspects of your software application lifecycle needs. With Micro Focus, you have access to standards-based, modular, multiplatform software coupled with global services and support.

To generate real-life loads and identify and diagnose problems, visit: software.microfocus.com/software/performance-testing

For an overview of Micro Focus software services, visit: microfocus.com/software/services

To access technical interactive support, visit Software Support Online at: softwaresupport.hpe.com

Learn More At
microfocus.com/loadrunner

www.microfocus.com



Micro Focus

UK Headquarters

United Kingdom
+44 (0) 1635 565200

U.S. Headquarters

Rockville, Maryland
301 838 5000
877 772 4450

Additional contact information and office locations:
www.microfocus.com

EXHIBIT H

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

To:

MCKINNEY JACK H.

**HEWLETT-PACKARD COMPANY INTELLECTUAL
PROPERTY ADMINISTRATION 3404 EAST HARMONY
ROAD, MAIL STOP 35 FORT COLLINS CO 80528 USA**

PCT

**WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY**

(PCT Rule 43bis.1)

Date of mailing
(day/month/year) **31 OCTOBER 2012 (31.10.2012)**

Applicant's or agent's file reference
82909016

FOR FURTHER ACTION

See paragraph 2 below

International application No.

PCT/US2012/024087

International filing date (day/month/year)

07 FEBRUARY 2012 (07.02.2012)

Priority date(day/month/year)

International Patent Classification (IPC) or both national classification and IPC

G06F 11/36(2006.01)i, H04W 24/00(2009.01)i

Applicant

HEWLETT-PACKARD DEVELOPMENT COMPANY, L.P. et al

1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☐ Box No. VII Certain defects in the international application
- ☐ Box No. VIII Certain observations on the international application

2. FURTHER ACTION

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1bis(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

Name and mailing address of the ISA/KR
Korean Intellectual Property Office
189 Cheongsa-ro, Seo-gu, Daejeon
Metropolitan City, 302-701,
Republic of Korea
Facsimile No. 82-42-472-7140

Date of completion of this opinion

31 OCTOBER 2012 (31.10.2012)

Authorized officer

Lee Byoung Soo

Telephone No.82-42-481-5697



**WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY**

International application No.

PCT/US2012/024087**Box No. I Basis of this opinion**

1. With regard to the **language**, this opinion has been established on the basis of :

- ☒ the international application in the language in which it was filed
- ☐ a translation of the international application into _____, which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b))

2. ☐ This opinion has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43*bis*.1(a))

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, this opinion has been established on the basis of:

a. a sequence listing filed or furnished

- ☐ on paper
- ☐ in electronic form

b. time of filing or furnishing

- ☐ contained in the international application as filed.
- ☐ filed together with the international application in electronic form.
- ☐ furnished subsequently to this Authority for the purposes of search.

4. ☐ In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

5. Additional comments:

**WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY**

International application No.

PCT/US2012/024087

Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	2-6,8-11,13-15	YES
	Claims	1,7,12	NO
Inventive step (IS)	Claims	NONE	YES
	Claims	1-15	NO
Industrial applicability (IA)	Claims	1-15	YES
	Claims	NONE	NO

2. Citations and explanations :

Reference is made to the following documents:

D1: US 7813910 B1 (POULIN DONAVAN) 12 October 2010
D2: US 2006-0282247 A1 (JAMES BRENNAN et al.) 14 December 2006
D3: US 2011-0161484 A1 (VAN DEN BOGAERT ETIENNE A. H. et al.) 30 June 2011
D4: US 2008-0139195 A1 (MARSYLA DAVID JOHN et al.) 12 June 2008

1. Novelty and Inventive Step

1.1. Independent Claims 1, 7, 12

D1, which is considered to represent the most relevant state of the art, discloses the method and an medium or system comprising steps of simulating a cellular network condition for each of a plurality of locations utilizing a network simulation engine, and testing performance of the mobile application for each of the simulated cellular network conditions.

As all of the features of claims 1, 7, 12 are disclosed in D1, these claims are anticipated by D1.

Therefore, claims 1, 7, 12 lack novelty over D1 under PCT Article 33(2).

1.2. Dependent Claims 2-6

Claims 2-6, dependent on claim 1, further define the execution type of the simulation, which can be easily invented by the person skilled in the art from D1 with his general knowledge.

Therefore, claims 2-6 lack an inventive step over D1 under PCT Article 33(3).

1.3. Dependent Claims 8-11

Claims 8-11, dependent on claim 7, further define the instructions, the simulated cellular network conditions and the mobile device, which can be easily invented by the person skilled in the art from D1 with his general knowledge.

Therefore, claims 8-11 lack an inventive step over D1 under PCT Article 33(3).

(Continued on the Supplemental Box)

**WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY**

International application No.

PCT/US2012/024087**Supplemental Box**

In case the space in any of the preceding boxes is not sufficient.

Continuation of :

Box V

1.4. Dependent Claims 13-15

Claims 13-15, dependent on claim 12, further define the first location and processing resource, which can be easily invented by the person skilled in the art from D1 with his general knowledge.

Therefore, claims 13-15 lack an inventive step over D1 under PCT Article 33(3).

2. Industrial Applicability

Claims 1~15 are considered to be industrially applicable under PCT Article 33(4).

EXHIBIT 2



BANK OF AMERICA

Claim 1, U.S. Pat. No. 8,924,192

Claim Element	Evidence of Infringement
<p>1. A system for developing an application for a mobile device comprising: a software authoring interface configured to simultaneously visually emulate, via one or more profile display windows, a plurality of network characteristics indicative of performance of the mobile device when executing the application; wherein the software authoring interface is further configured to simulate a network connection state encountered by the mobile device.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 2, U.S. Pat. No. 8,924,192

Claim Element	Evidence of Infringement
<p>2. The system of claim 1, wherein the software authoring interface is configured to enable a user to select from one or more connection simulations for testing how well mobile content performs on the mobile device.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 3, U.S. Pat. No. 8,924,192

Claim Element	Evidence of Infringement
<p>3. The system of claim 2, wherein the one or more connection simulations are configured to simulate wireless transmission of content to the mobile device based on the selected connection simulation.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 4, U.S. Pat. No. 8,924,192

Claim Element	Evidence of Infringement
<p>4. The system of claim 2, wherein the connection simulation includes one or more profiles.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 5, U.S. Pat. No. 8,924,192

Claim Element	Evidence of Infringement
<p>5. The system of claim 4, wherein the profiles include preset profiles.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 6, U.S. Pat. No. 8,924,192

Claim Element	Evidence of Infringement
<p>6. The system of claim 4, wherein the profiles are configured to enable a user to manage the profiles.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 7, U.S. Pat. No. 8,924,192

Claim Element	Evidence of Infringement
<p>7. The system of claim 4, wherein the profiles are configured to enable a user to create custom profiles.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 8, U.S. Pat. No. 8,924,192

Claim Element	Evidence of Infringement
<p>8. The system of claim 2, wherein the one or more connection simulations are based on different connection statistics reported by one or more mobile devices used in non-simulated environments.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 9, U.S. Pat. No. 8,924,192

Claim Element	Evidence of Infringement
<p>9. The system of claim 2, wherein the one or more connection simulations are based on data of interaction with network operators in non-simulated environments.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 10, U.S. Pat. No. 8,924,192

Claim Element	Evidence of Infringement
<p>10. The system of claim 9, wherein the data includes live network profiles, real-time bandwidth profiles, or both.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 11, U.S. Pat. No. 8,924,192

Claim Element	Evidence of Infringement
<p>11. The system of claim 9, wherein the data includes data representing one or more mobile devices.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 12, U.S. Pat. No. 8,924,192

Claim Element	Evidence of Infringement
<p>12. The system of claim 1, wherein the software authoring interface is configured to allow a user to simulate an incoming sms message.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 13, U.S. Pat. No. 8,924,192

Claim Element	Evidence of Infringement
<p>13. The system of claim 1, wherein the software authoring interface is configured to allow a user to simulate an incoming phone call.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 14, U.S. Pat. No. 8,924,192

Claim Element	Evidence of Infringement
<p>14. The system of claim 1, further comprising a testing interface configured to accept user inputs for selecting available simulated or non-simulated connection states.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 15, U.S. Pat. No. 8,924,192

Claim Element	Evidence of Infringement
<p>15. The system of claim 1, wherein the software authoring interface has access to mobile devices in geographical markets worldwide to create simulated and/or non-simulated network environments.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 16, U.S. Pat. No. 8,924,192

Claim Element	Evidence of Infringement
<p>16. The system of claim 1, wherein the software authoring interface has access to real-time interaction with network operators to measure and emulate network characteristics.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 60, U.S. Pat. No. 8,924,192

Claim Element	Evidence of Infringement
<p>60. A system comprising: an application configured to enable a user to modify a photo on the mobile device, wherein the application is developed using a software authoring platform configured to simultaneously visually emulate, via one or more profile display windows, a plurality of hardware characteristics indicative of performance of the mobile device when executing the application.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 61, U.S. Pat. No. 8,924,192

Claim Element	Evidence of Infringement
<p>61. The system of claim 60, wherein the application is configured to allow an end user to add content to modify the photo.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 62, U.S. Pat. No. 8,924,192

Claim Element	Evidence of Infringement
<p>62. The system of claim 61, wherein the content includes text.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 63, U.S. Pat. No. 8,924,192

Claim Element	Evidence of Infringement
<p>63. The system of claim 62, wherein the text includes a caption.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 64 U.S. Pat. No. 8,924,192

Claim Element	Evidence of Infringement
<p>64. The system of claim 61, wherein the content includes an image, animation, or both.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 65, U.S. Pat. No. 8,924,192

Claim Element	Evidence of Infringement
<p>65. The system of claim 60, wherein the application is configured to allow an end user to distribute the modified photo through a server or other connection to the internet.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 66, U.S. Pat. No. 8,924,192

Claim Element	Evidence of Infringement
<p>66. The system of claim 60, wherein the application is configured to allow an end user to manage or update the modified photo or photo application through a server or other connection to the internet.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 67, U.S. Pat. No. 8,924,192

Claim Element	Evidence of Infringement
<p>67. The system of claim 60, wherein mobile revenues are created using the modified photo or application.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 68, U.S. Pat. No. 8,924,192

Claim Element	Evidence of Infringement
<p>68. The system of claim 67, wherein the revenues include ads.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 69, U.S. Pat. No. 8,924,192

Claim Element	Evidence of Infringement
<p>69. The system of claim 67, wherein the revenues include brand marketing.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>



BANK OF AMERICA

Claim 1, U.S. Pat. No. 9,298,864

Claim Element	Evidence of Infringement
<p>1. A system for testing an application for a mobile device comprising: software configured to simulate, via one or more profile display windows, a plurality of network characteristics indicative of performance of the mobile device when executing the application; wherein the network characteristics are based on data of interaction with networks in non-simulated environments.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 2, U.S. Pat. No. 9,298,864

Claim Element	Evidence of Infringement
<p>2. The system of claim 1, wherein the software is further configured to capture network profiles from a plurality of geographical locations.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 3, U.S. Pat. No. 9,298,864

Claim Element	Evidence of Infringement
<p>3. The system of claim 2, wherein the network profiles can either be saved in a storage medium, or stored on a server, or both.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 4, U.S. Pat. No. 9,298,864

Claim Element	Evidence of Infringement
<p>4. The system of claim 3, wherein the software is further configured to access a library of network profiles.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 5, U.S. Pat. No. 9,298,864

Claim Element	Evidence of Infringement
<p>5. The system of claim 4, wherein the network profiles are displayed using either a map, or a pull-down list, or both.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 6, U.S. Pat. No. 9,298,864

Claim Element	Evidence of Infringement
<p>6. The system of claim 1, wherein the data includes either live network profiles, or real-time bandwidth profiles, or both.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 7, U.S. Pat. No. 9,298,864

Claim Element	Evidence of Infringement
<p>7. The system of claim 1, wherein the one or more network characteristics are based on data of interaction with one or more mobile devices used in non-simulated environments.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 8, U.S. Pat. No. 9,298,864

Claim Element	Evidence of Infringement
<p>8. The system of claim 1, wherein the software is further configured to create one or more scenarios that include scripts that impact either the performance of the application, or the network, or both.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 9, U.S. Pat. No. 9,298,864

Claim Element	Evidence of Infringement
<p>9. The system of claim 8, wherein the one or more scenarios define one or more events that occur during the test which includes defining one or more virtual users to simulate real users.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 10, U.S. Pat. No. 9,298,864

Claim Element	Evidence of Infringement
<p>10. The system of claim 9, wherein the one or more virtual users emulate actions of real user behavior.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 11, U.S. Pat. No. 9,298,864

Claim Element	Evidence of Infringement
<p>11. The system of claim 10, wherein the actions that are performed by one or more virtual users are recorded to generate a script which can be modified to emulate real user behavior.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 12, U.S. Pat. No. 9,298,864

Claim Element	Evidence of Infringement
<p>12. The system of claim 11, wherein the scripts include one or more functions that measure and record performance of either the application, or the network, or both.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 13, U.S. Pat. No. 9,298,864

Claim Element	Evidence of Infringement
<p>13. The system of claim 1, wherein the software is further configured to display data graphically which is configured to enable a user to identify either application performance, or network performance, or both.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 14, U.S. Pat. No. 9,298,864

Claim Element	Evidence of Infringement
<p>14. The system of claim 1, wherein the software is further configured to interact with a network to enable a user to update the software.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 15, U.S. Pat. No. 9,298,864

Claim Element	Evidence of Infringement
<p>15. The system of claim 1, wherein the software is further configured to be hosted by either a vendor, or a service provider, or both and distributed to one or more users via the internet.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 16, U.S. Pat. No. 9,298,864

Claim Element	Evidence of Infringement
<p>16. The system of claim 15, wherein either the vendor, or the service provider, or both charge fees for using the software.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 17, U.S. Pat. No. 9,298,864

Claim Element	Evidence of Infringement
<p>17. The system of claim 1, wherein the software is further configured to enable a user to select from one or more network characteristics for testing how well mobile content performs on the mobile device.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 18, U.S. Pat. No. 9,298,864

Claim Element	Evidence of Infringement
<p>18. The system of claim 17, wherein the network characteristics includes one or more network profiles.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 19, U.S. Pat. No. 9,298,864

Claim Element	Evidence of Infringement
<p>19. The system of claim 18, wherein the network profiles are configured to enable a user to either manage the profiles, or create custom profiles, or both.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 20, U.S. Pat. No. 9,298,864

Claim Element	Evidence of Infringement
<p>20. A method for emulating an application playing on an application player in each of a plurality of mobile devices, the method comprising: retrieving characteristics, indicative of performance, for each of the mobile devices; emulating each of the mobile devices in real time using respective models running on a processor extrinsic to the mobile devices, wherein each of the models is based on the retrieved characteristics; playing the application in real time using the application player within each of the models; monitoring the application playing in each of the models to determine resource utilization information by the application for each of the mobile devices; and displaying the resource utilization information for at least one of the mobile devices.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 21, U.S. Pat. No. 9,298,864

Claim Element	Evidence of Infringement
<p>21. The method of claim 20, wherein the step of displaying comprises displaying the resource utilization information graphically using a timeline numbered to indicate points in time during the execution of the application.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 22, U.S. Pat. No. 9,298,864

Claim Element	Evidence of Infringement
<p>22. The method of claim 20, wherein the step of retrieving further includes interacting with a user to select the plurality of mobile devices from a list of mobile devices stored in a library containing characteristics indicative of performance of the mobile devices.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 23, U.S. Pat. No. 9,298,864

Claim Element	Evidence of Infringement
<p>23. The method of claim 20, wherein step of emulating comprises: determining, based upon the characteristics, for each mobile device: the display size of the mobile device; the amount of random access memory (RAM); the amount of non-volatile memory; and the processor speed; and for each said mobile device, generating the respective model based upon one or more of the display size, the amount of RAM, the amount of non-volatile memory, and the processor type.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 24, U.S. Pat. No. 9,298,864

Claim Element	Evidence of Infringement
<p>24. The method of claim 20, wherein the steps of playing and monitoring simulate execution of one or more frames of a frame-based application.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 25, U.S. Pat. No. 9,298,864

Claim Element	Evidence of Infringement
<p>25. The method of claim 20, further comprising identifying one or more frames of a frame-based application where resource utilization of the application exceeds a maximum resource availability threshold of any one of the mobile devices.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 26, U.S. Pat. No. 9,298,864

Claim Element	Evidence of Infringement
<p>26. The method of claim 25, further comprising displaying the first identified frame of the application to indicate a crash of the application on the emulated mobile device.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 27, U.S. Pat. No. 9,298,864

Claim Element	Evidence of Infringement
<p>27. The method of claim 20, further comprising identifying one or more frames of a frame-based application where resource utilization of the application exceeds a maximum resource availability threshold of any one of the mobile devices, wherein the threshold defaults to a maximum resource availability for the emulated mobile device.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 28, U.S. Pat. No. 9,298,864

Claim Element	Evidence of Infringement
<p>28. The method of claim 20, further comprising identifying one or more frames of a frame-based application where resource utilization of the application exceeds a maximum resource availability threshold of any one of the mobile devices, wherein the threshold is modified to dynamically adjust resource availability to the application.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 29, U.S. Pat. No. 9,298,864

Claim Element	Evidence of Infringement
<p>29. A method for emulating an application playing on at least one mobile device comprising: receiving instructions to select each said mobile device from a list including characteristics indicative of performance of each said mobile device; emulating each said mobile device using a respective model, wherein each said model is based upon the characteristics of a respective said mobile device; playing the application in real time within each said model; monitoring each said model to determine resource utilization of the application for each said mobile device; and displaying the resource utilization information.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 30, U.S. Pat. No. 9,298,864

Claim Element	Evidence of Infringement
<p>30. The method of claim 29, further comprising publishing the application to the mobile device once resource utilization is determined to be within available resources of the mobile device.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 31, U.S. Pat. No. 9,298,864

Claim Element	Evidence of Infringement
<p>31. A method for emulating a frame-based application playing on a mobile device that includes an application player, the method comprising: retrieving characteristics indicative of performance of the mobile device; emulating, on a processor extrinsic to the mobile device, the mobile device as a model based upon the retrieved characteristics; playing the application in real time within the model; monitoring the application playing in the model to determine utilization of the mobile device's resources by the application; identifying a frame of the application where resource utilization by the application exceeds a maximum resource availability threshold of the mobile device; and displaying the identified frame to indicate a crash of the application on the emulated mobile device.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 32, U.S. Pat. No. 9,298,864

Claim Element	Evidence of Infringement
<p>32. A method for developing an application to play on a mobile device that includes an application player, the method comprising: downloading, via the Internet, computer-readable instructions for executing the application; determining resource utilization of the application when executed on the mobile device by: emulating the mobile device on a processor extrinsic to the mobile device using a model based on the characteristics; loading the application into the model; and monitoring the application playing in real time within the model to determine resource utilization of the application for the mobile device; and repeating the steps of receiving and determining until the resource utilization when running the application is no greater than resource availability of the mobile device.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 33, U.S. Pat. No. 9,298,864

Claim Element	Evidence of Infringement
<p>33. The method of claim 32, further comprising selecting the mobile device from a list of mobile devices containing characteristics indicative of performance of the mobile devices.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 34, U.S. Pat. No. 9,298,864

Claim Element	Evidence of Infringement
<p>34. The method of claim 33, wherein the step of downloading is responsive to an online payment to a third party.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 35, U.S. Pat. No. 9,298,864

Claim Element	Evidence of Infringement
<p>35. The method of claim 34, wherein the online payment comprises one of a subscription fee and a usage fee.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 36, U.S. Pat. No. 9,298,864

Claim Element	Evidence of Infringement
<p>36. A software product comprising instructions, stored on computer-readable media, wherein the instructions, when executed by a computer, perform steps emulating and profiling a frame-based application to play on a plurality of mobile devices each including an application player, comprising: instructions for retrieving characteristics indicative of performance for each of the mobile devices; instructions for emulating each of the mobile devices on a processor extrinsic thereto using a respective model based upon the characteristics for each respective model; instructions for playing the application within each of the models; and instructions for monitoring the application playing in each of the models to determine resource utilization of the application for each of the mobile devices.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 37, U.S. Pat. No. 9,298,864

Claim Element	Evidence of Infringement
<p>37. An emulator for profiling an application running on a plurality of mobile devices comprising: a model of each of the mobile devices based upon characteristics of the respective mobile device; wherein the model uses an application player to play the application within each of the models on a processor extrinsic to the mobile device; and a monitor for determining resource utilization of the application when played by the respective mobile device.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 38, U.S. Pat. No. 9,298,864

Claim Element	Evidence of Infringement
<p>38. The emulator of claim 37, wherein the monitor comprises means for displaying the resource utilization relative to a particular point in time during the execution of the application.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 39, U.S. Pat. No. 9,298,864

Claim Element	Evidence of Infringement
<p>39. A development server for supporting a plurality of environments for developing applications to run on a plurality of mobile devices, comprising: a network profile library storing one or more network profiles defining operation of a communication network for communicating with the mobile devices; and a device model library storing one or more mobile devices.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 40, U.S. Pat. No. 9,298,864

Claim Element	Evidence of Infringement
<p>40. The development server of claim 39, wherein the device model defines a player for running the applications on the device models.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 41, U.S. Pat. No. 9,298,864

Claim Element	Evidence of Infringement
<p>41. The development server of claim 39, further comprising an emulator for emulating the applications in real time on a processor extrinsic to the mobile devices, wherein the output of the emulator is published to one or more of the environments.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>



BANK OF AMERICA

Claim 1, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
<p>1. A system for testing an application for a mobile device comprising: a software testing interface configured to simultaneously visually simulate, via one or more profile display windows, a plurality of operator network characteristics including at least bandwidth availability indicative of performance of the mobile device when executing the application; wherein the bandwidth availability is based at least in part on bandwidth data predetermined from interactions between one or more mobile devices and at least one operator network.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 2, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
<p>2. The system of claim 1, wherein the software is configured to enable a user to select from one or more connection simulations for testing how well mobile content performs on the mobile device.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 3, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
<p>3. The system of claim 2, wherein the one or more connection simulations are configured to simulate wireless transmission of content to the mobile device based on the selected connection simulation.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 4, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
<p>4. The system of claim 2, wherein the connection simulation includes one or more profiles.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 5, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
<p>5. The system of claim 4, wherein the profiles include preset profiles.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 6, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
<p>6. The system of claim 4, wherein the profiles are configured to enable a user to manage the profiles.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 7, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
<p>7. The system of claim 4, wherein the profiles are configured to enable a user to create custom profiles.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 8, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
<p>8. The system of claim 2, wherein the one or more connection simulations are based on different connection statistics reported by one or more mobile devices used in non-simulated environments.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 9, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
<p>9. The system of claim 2, wherein the one or more connection simulations are based on data of interaction with network operators in non-simulated environments.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 10, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
<p>10. The system of claim 9, wherein the data includes either live network profiles, or real-time bandwidth profiles, or both.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 11, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
<p>11. The system of claim 9, wherein the data includes data representing one or more mobile devices.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 12, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
<p>12. The system of claim 1, wherein the software is configured to allow a user to simulate an incoming sms message.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 13, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
<p>13. The system of claim 1, wherein the software is configured to allow a user to simulate an incoming phone call.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 14, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
<p>14. The system of claim 1, further comprising a testing interface configured to accept user inputs for selecting available simulated and/or non-simulated connection states.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 15, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
<p>15. The system of claim 1, wherein the software has access to mobile devices in geographical locations worldwide to create simulated and/or non-simulated network environments.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 16, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
<p>16. The system of claim 1, wherein the software has access to real-time interaction with network operators to measure and simulate network characteristics.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 17, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
<p>17. The system of claim 1, wherein the software has access to one or more operator networks in geographical locations worldwide to create either simulated network environments, or non-simulated network environments, or both.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 18, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
<p>18. The system of claim 1, wherein the software is configured to enable a user to select from one or more operator networks in geographical locations worldwide to create a network environment.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 19, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
<p>19. The system of claim 18, wherein the one or more operator networks are displayed using either a map, or a pull-down list, or both.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 20, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
<p>20. The system of claim 18, wherein the network environment is based upon either a bandwidth, or data transfer, or both associated with the operator network.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 21, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
<p>21. The system of claim 1, wherein the software is further configured to display data to identify application performance.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 22, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
<p>22. The system of claim 21, wherein the user can manage the data.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 23, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
<p>23. The system of claim 1, wherein the software includes fees for interacting with the network.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 24, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
<p>24. The system of claim 1, wherein the software includes fees for downloading updates.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 25, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
<p>25. The system of claim 1, wherein the software includes fees for content management services.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 26, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
<p>26. A system for testing an application for a mobile device comprising: a software testing interface configured to simultaneously visually simulate, via one or more profile display windows, a plurality of operator network characteristics including at least bandwidth availability indicative of performance of the mobile device when executing the application; wherein the bandwidth availability is based at least in part on bandwidth data predetermined from interactions between one or more mobile devices and at least one operator network and the software is further configured to display data of either application performance, or network performance, or both.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 27, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
<p>27. The system of claim 26, wherein the data is displayed graphically.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 28, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
<p>28. The system of claim 26, wherein the data includes interaction with either simulated network environments, or non-simulated network environments, or both.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 29, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
<p>29. The system of claim 26, wherein the data includes resource utilization of either application performance, or network performance, or both.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 30, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
<p>30. The system of claim 29, wherein the resource utilization information is displayed graphically.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 31, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
<p>31. The system of claim 29, wherein the resource utilization includes interaction with a network.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 32, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
<p>32. The system of claim 29, wherein the resource utilization includes either live network effects, or scripted network effects, or both.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 33, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
<p>33. The system of claim 26, wherein the data is configured to enable a user to identify performance of either the application, or network, or both.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 34, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
<p>34. The system of claim 26, wherein the data is configured to enable a user to evaluate performance of either the application, or network, or both.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 35, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
<p>35. The system of claim 26, wherein the data is configured to enable a user to correct application performance.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 36, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
<p>36. The system of claim 26, wherein the data is configured to enable a user to either manage the data, or modify the data, or both.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 37, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
<p>37. A system for testing an application for a mobile device comprising: a software testing interface configured to simultaneously visually simulate, via one or more profile display windows, a plurality of operator network characteristics including at least bandwidth availability indicative of performance of the mobile device when executing the application; wherein the bandwidth availability is based at least in part on bandwidth data predetermined from interactions between one or more mobile devices and at least one operator network and the software is further configured to interact with a network.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 38, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
<p>38. The system of claim 37, wherein interaction with a network enables a user to update the software.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 39, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
<p>39. A development server for supporting a plurality of environments for developing applications to run on a plurality of mobile devices, comprising: a network profile library storing one or more network profiles defining operation of a communication network for communicating with the mobile devices; and a device model library storing one or more mobile devices.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 40, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
<p>40. The system of claim 37, wherein interaction with a network enables a user to interact with one or more operator networks.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 41, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
<p>41. The system of claim 40, wherein interaction with one or more operator networks enables a user to update either network characteristics, or device characteristics, or both.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 42, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
<p>42. The system of claim 37, wherein the software includes fees for interacting with the network.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 43, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
<p>43. The system of claim 37, wherein the software includes fees for downloading updates.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 44, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
<p>44. The system of claim 37, wherein the software includes fees for content management services.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 45, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
<p>45. A system for testing an application for a mobile device comprising: a software testing interface configured to simultaneously visually simulate, via one or more profile display windows, a plurality of operator network characteristics including at least bandwidth availability indicative of performance of the mobile device when executing the application; wherein the bandwidth availability is based at least in part on bandwidth data predetermined from interactions between one or more mobile devices and at least one operator network and interaction with a network enables the software to import real-world mobile network profiles.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 46, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
<p>46. The system of claim 45, wherein the software is further configured to allow tests to be managed and results analyzed from a personal computer or mobile device.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 47, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
<p>47. The system of claim 45, wherein the software can import real-world mobile network profiles captured by one or more networks.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 48, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
<p>48. The system of claim 45, wherein the software can import real-world mobile network profiles provided by a storage library of mobile network conditions.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 49, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
<p>49. The system of claim 45, wherein the software can import real-world mobile network profiles from geographical locations worldwide.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>

Claim 50, U.S. Pat. No. 9,971,678

Claim Element	Evidence of Infringement
<p>50. The system of claim 45, wherein the software enables a user to discover and import network conditions from geographical locations worldwide.</p>	<p>Bank of America has proprietary software products, that may also integrate third party development tools, for the development and testing of mobile applications that are believed to meet the elements of this claim. On information and belief, Bank of America has developed their own Bank of America-related products that are believed to be infringing, including at least a product named UI TestRunner. As these are software products whose functionality cannot be discerned from publicly available sources, Wapp has served discovery on Bank of America seeking additional information and will supplement these charts once such discovery has been produced.</p>